Inflation Targeting in Norway

To what extent can Norges Bank control Inflation?

Inge Helland Berqvam

Master's Thesis in Economics

Department of Economics

University of Oslo

The war has taught the government, and the government has taught the people, that federal taxation has much to do with inflation and deflation, with the prices which have to be paid for the things which are bought and sold. If federal taxes are insufficient or of the wrong kind, the purchasing power in the hands of the public is likely to be greater than the output of goods and services with which this purchasing demand can be satisfied. If the demand becomes too great, the result will be a rise in prices, and there will be no proportionate increase in the quantity of things for sale. This will mean that the dollar is worth less than it was before – that is inflation. On the other hand, if federal taxes are too heavy or are of the wrong kind, effective purchasing power in the hands of the public will be insufficient to take from the producers of goods and services all the things these producers would like to make. This will mean widespread unemployment […].The dollars the government spends become purchasing power in the hands of the people who have received them. The dollars the government takes by taxes cannot be spent by the people, and therefore, these dollars can no longer be used to acquire the things which are available for sale. Taxation is, therefore, an instrument of the first importance in the administration of any fiscal and monetary policy.

Beardsley Ruml[1]

[1] Page 36 in Ruml, Beardsley. 1946. *Taxes for Revenue is Obsolete.* American Affairs, January 1946. Vol VIII, No.1

2013

Inflation Targeting in Norway: To what extent can Norges Bank control Inflation?

Inge Helland Berqvam

http://www.duo.uio.no/

Print : Reprosentralen, Universitetet i Oslo

PREFACE

I would like to thank my supervisor, Professor Asbjørn Rødseth for his invaluable input and help with my thesis. This includes discussions, commentaries, questions and not at least suggestions. The latter not only improved the thesis, but also made me learn much more than expected from writing it.

I would also thank the helpful staff at The Faculty of Economics at the University of Oslo, and the professors of the classes I have attended. I would also thank the staff at Statistics Norway (SSB) for answering questions on demand.

At last I will also thank my family and friends for their support while working on my thesis.

Any errors or inaccuracies in the thesis are my own responsibility.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

1 Introduction

In this paper I question Norges Banks ability to fine-tune inflation, as measured by the Norwegian Consumer Price Index, KPI, by monetary policy. I will base my critique of Inflation targeting (IT) on the school of Post-Keynesian economics. Post-Keynesians are not necessarily against IT per se, but they criticize how IT has caused fiscal policy to decline in importance, both as a tool to stabilize the economy and to control inflation. IT is considered very successful among its proponents. Countries adopting IT have experienced falling inflation, and for the most part have met their inflation targets. Not a single country adopting IT has later abandoned it. However, countries not implementing IT have also for the most part experienced falling inflation rates, causing some observers to attribute the fall in world-wide inflation to other phenomenon. At the same time recent experiences from the US and the EU shows that low and stable inflation do not necessarily guarantee healthy economic performance. I firmly believe that this is a result of degrading of fiscal policy as tool of achieving economic growth. This does not mean I reject the value of IT, or try to underestimate the theory achievements. However, I feel the debate between fiscal and monetary policy has been either or, with proponents of monetary policy winning. This is a serious problem if monetary policy is not powerful enough to counter a severe crisis.

The paper is two-fold; first I provide a survey of important ingredients of inflation targeting, and then following up with some empirical evidence, trying to penetrate the effectiveness of IT. I will start out with a description of the transmission mechanism for monetary policy. Present the measures of inflation used in IT, followed by a presentation of the components in KPI. I then discuss

changes in monetary regimes in Norway since 1979 and a short description of fiscal policy in Norway.

I use two methods to explore the extent Norges Bank can control inflation as measured by the Norwegian Consumer Price Index, KPI. First I follow Papadimitreou and Wray (1996) by inspecting the different subcomponents of KPI to see how likely it is that monetary policy can influence their prices compared to other factors. Here I will focus on direct effects, as secondary effects presumably can spill over into all of the components. I will then look at the weighted contribution to headline inflation from the components singled out to be most problematic.

I will also follow a more quantitative approach by looking at inflation persistence of the individual components of the CPI, and to check if they are stationary. I will look at four different time periods from 1979 until today. The periods are divided into these periods because they represent different monetary regimes. If IT has been successful in bringing down inflation, we would expect inflation persistence to be quite low, we would also expect declining inflation persistence compared to past monetary regimes.

One conclusion is that Norges Bank cannot directly influence large parts of the CPI, and that those components constitute a large portion of the weighed inflation of the CPI. That brings up the question whether the components should be removed from the measures of inflation used by Norges Bank. At the same time I find that inflation persistence has almost disappeared after the inception of IT. This suggests that IT have been successful at anchoring inflation around its target.

2 Transmission Mechanism of Monetary Policy

This is meant to be a short survey of the transmission mechanism of monetary policy. The control variable of the central bank is the short term interest rate. Previously there have been attempts by central banks to control different measures of the money supply; however, this is now mostly abandoned. As customary I will divide the Transmission mechanism of monetary policy into different channels. These channels are:

Interest rate channel

Exchange rate channel

Asset price channel

Credit channel

The broad Credit channel

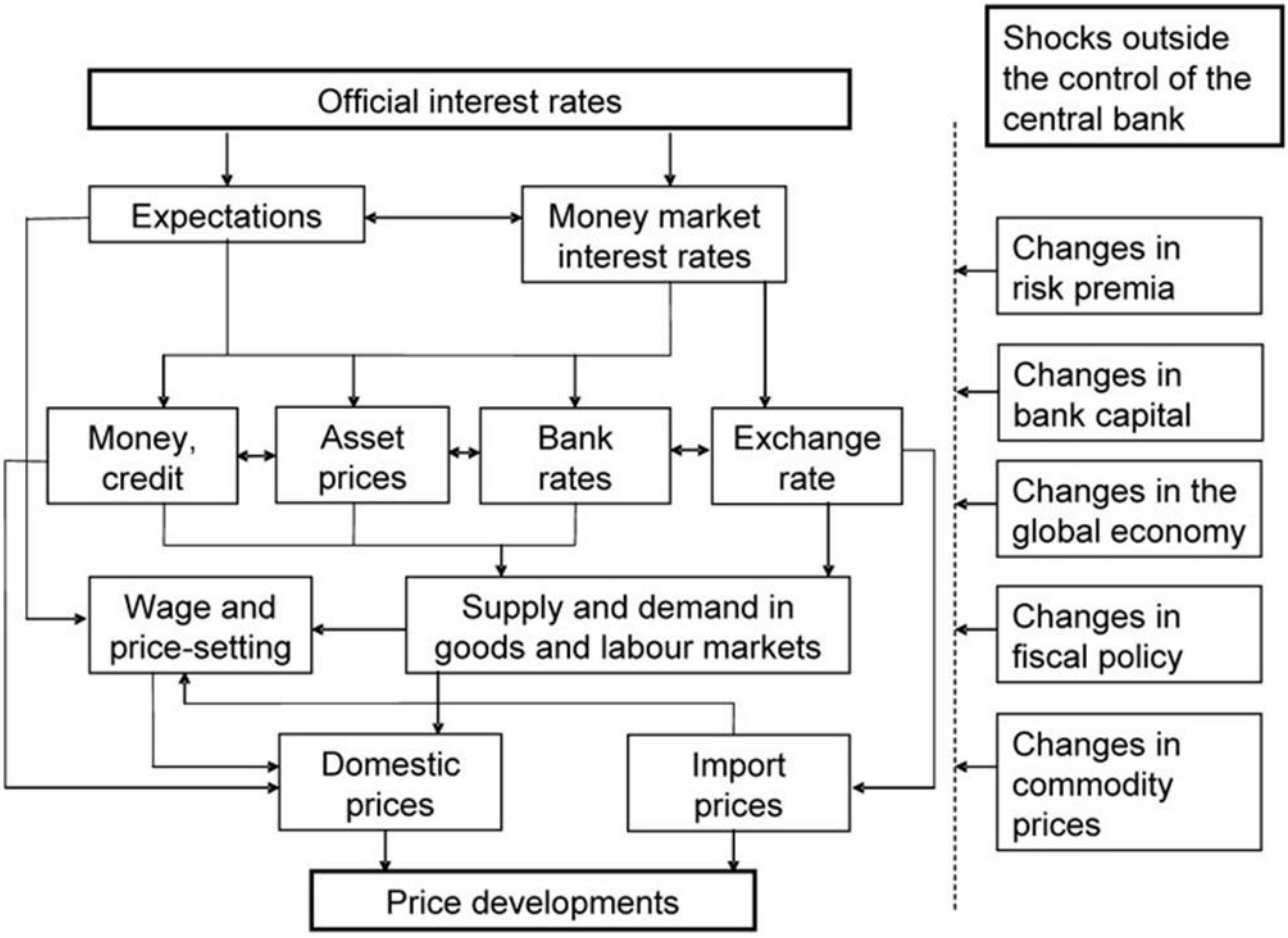
Expectation channel

Interest payments on government bonds

The first six channels are the ones usually listed by scholars and central bankers alike. I have also included a seventh channel which opens for the possibility that changes in interest payments done by the government influence inflation. This depends on a set of assumptions I will return to later. I will go over these channels one by one, along with a short explanation. The effects from the channels on headline inflation will depend on a variety of factors, which is country specific and will change over time. Figure 1 illustrates the interactions of the different channels. The complex nature of the transmission mechanism makes it hard to separate the effects from different channels. To further

complicate the picture, shocks outside of the control of the central bank influence inflation.

Figure 1. Transmission Mechanism of Monetary Policy



Source: ECB

2.1 Interest Rate Channel

As a monopoly supplier of bank reserves Norges Bank can freely set the short-term interest rate. Norges Bank controls the rate by offering interest rate on bank reserves, which creates a floor for interest rates in the economy. Depending on expectations, a change in short-term interest rate will cause changes in the

money-markets rates and long-term interest rates. Presumably interest rate changes will influence business investments and household demand for durables, including housing, in the same direction. Increasingly household's also finance consumption of non-durables with credit. In Norway most households choose a floating interest rate on their mortgages. Hence, an increase of short term interest rates will cut disposable income for most households that are in debt. However, interest effects on consumption depend on the differences of the marginal propensity to consume, MPC, between creditors and debtors. If MPC is, as often assumed, higher among debtors than creditors the isolated effect of an increase in interest rates will be GDP contraction. My guess is that this effect of the interest channel will mainly be determined by the interest elasticity of investments. In Norway its absolute value is rather high for household for durables and housing, whole less so for business.

A natural consequence of exogenous interest rates in an economy with a floating currency is that Norges Bank will not set interest rates so high as to create a credit crunch. At least not on purpose since this will conflict its mandate of promoting a robust and efficient financial system. The large private debt relatively to GDP in Norway puts a ceiling on the level of the interest rates that Norges Bank in practice can choose from. Theoretically it is conceivable that a situation can occur where interest rates hits that ceiling while still not high enough to curb inflation. Hence, a conflict can arise between Norges Bank's different mandates.

The theory of intertemporal substitution of consumption suggests that consumers transfer consumption to the future confronted with interest rate hikes. Assuming consumers have concave utility functions. Hence, an increase in the interest rate increases household savings.

Interest rates influence cost of goods because of inventories and goods under production. The latter effect will be most influential for durable goods that take

a long time to produce. The cost pass-through will determine how much of the increases in cost will be passed on to consumers.

2.2 Exchange Rate Channel

All other factors equal economic theory suggests that unexpected change in the interest rate will change the exchange rate in the same direction. If the interest rate is reduced imported goods and services become more expensive, while the ones exported will become cheaper, stimulating domestic demand. Hence, a depreciation of the Norwegian krone will increase inflation. How much the change in the exchange rate affects consumer prices depends on exchange rate pass-through. The degree of the exchange rate pass-through is defined as elasticity of import prices with respect to the exchange rate, Rødseth (2000). Norges Banks ability to influence this channel depends on the elasticity of the exchange rate with respect to the interest rate. Because of the importance of this channel I will provide a short discussion, as well as some empirical results.

For most goods and services pass-through is not complete, which means it is less than one.

Mishkin (2008) provides reasons:

Price to market, which assumes monopolistically competitive markets, where optimizing firms vary their mark-up across different national markets depending on the elasticity of demand they face in each market. If the currency of the exporter's country appreciates he will reduce mark-up to maintain market shares.

Local currency pricing, which means that an exporter sets the price of the good in the currency of the country to which it export, this leads to lower pass-through in combination with nominal price rigidities. This impact is largest for

big markets like the US; in a small country there are fewer firms that produce close substitutes to imports. Rødseth (2000). This is opposite to producer currency pricing where it is assumed that prices are set in the currency of the exporter, this implies full pass-through.

Distribution cost make up a considerable part of the retail cost of imported goods.

Cross-border production lowers pass-through because the final good embodies cost in various currencies that may not all move together.

Mishkin (2008) surveys empirical evidence of pass-through, and cites Gagnon and Ihrig (2004), who estimated pass-through in a set of 20 industrial countries over the 1971-2000 period to be roughly 0.2, with most of the adjustment occurring quickly. By splitting their sample using country specific break-points they found that pass-through has fallen over time. In the last period of their sample they found pass-through to be only 0.05. Mishkin (2008) also cites Marazzi and Sheets (2007), who claims that pass-through to import prices fell from around 0.5 in the 1970s and 1980s to 0.2 in the 1990s. The decline in responsiveness was especially apparent in consumer goods, capital goods excluding computers and semi-conductors and automotive products suggesting pass-through is different for different goods and services.

For Norway Naug and Nymoen (1996) find that the exchange rate pass-through to be 0.6 for manufactured imports to Norway.

Boug et al (2005) have modeled exchange rate pass-through in Norway, with the added benefit of looking at pass-through effects on components of the CPI. In their model they assume producer currency pricing for import prices, or equivalently wholesale prices, while assuming local currency pricing for retail prices. They include profitability effects in export and import sector as well as potential wage-price spiral caused by the currency depreciation. In their model

pass-through will be complete in the long run by assumption; however the pass-through is muted in the short run because of mark-ups in the distribution sector move in the same direction as the exchange rate. The estimated effects can be seen inTable1.

Table 1. Exchange rate pass-through in Norway.

Consumer price effects of 10 percent exchange rate depreciation (on a permanent basis). Deviations from baseline scenario.

	1. year	2. year	3. year	4. year	5.year
Food	1.7	3.5	3.9	4.1	6.4
Beverages	1.8	3.5	4.1	4.5	6.6
Tobacco	1.6	3.5	3.9	4	6.2
Petrol	2.5	4.6	5.3	5.7	7.6
Electricity, heating oil etc.	1.8	3.7	4.1	4.6	6.3
Clothing and footwear	3.3	5.3	5.3	5.4	7.1
Cars	3.8	4.9	5.3	5.6	7.2
Furniture, electrical appliances	2.7	4.7	5	5.2	7.1
Housing	0	1	1.9	1.8	3.9
Public Transport	0.1	0.7	1.3	1.7	3.7
Health Care	0.8	1.9	2.7	3.2	5.6
Other goods	2.6	4.8	5	5.1	7.1
Other services	0.8	1.9	2.6	3.1	5.5
Trade margins	0.8	4.2	3.7	3.3	6
CPI-Inflation	1.6	1.4	0.6	0.2	0.2
Consumer Price Index	1.6	3	3.6	3.8	5.8

Pass-through is larger on goods than services; this reflects the large import shares of goods. Since trade margins rise less than CPI-inflation the pass-through to consumer prices is delayed in the first year. We note that the pass-through is not complete even after five years. Trade margins increase a lot in the second year contributing to persistence in the CPI inflation. The authors conclude that even if the pass-through is rather slow, changes in the exchange rate have substantial effect on headline inflation, both in the short and long run.

Bjørnland and Hungnes (2006) forecast the exchange rate of the krone based on a model with purchasing power parity and the differential between the domestic and foreign interest rate. They show that their model does perform better than a random walk, however only if the interest rate differential is included.

Naug (2004) regress the change in the exchange rate of the krone on the lag of the level and on its own lag, the oil price, a measure of exchange rate volatility, lags of the interest rate differential. He also look at movements in international stock prices, here he expects the krone to appreciate if investors expect low risk adjusted return in the stock market, assuming they will net buy assets in currencies with high yield. He also includes a stochastic trend to capture effects of unobserved variables that might affect the risk premium and exchange rate expectations.

He estimates that roughly 40 percent of the appreciation was due to interest rate increases. On average he expects a permanent increase in the interest rate differential will produce currency shifts all others variables constant, as shown in Table 2:

Table 2. Effects on the exchange rate of a 1 percentage point increase in the interest rate.

Months after change	0	5	9	12	48
Increase in interest rate differential by 1 percentage point	-2	-3.5	-6	-6.1	-6.1

Sorce: Naug (2004)

Naug also note that how sensitive the krone is to the interest rate differential depends on other variables, making it difficult for Norges Bank to calculate the effect at a given point in time.

Norges Bank only looks at the exchange rate to the extent it influences headline inflation. Since the krone is floating they do not need it to hit a specific target, but should at least be able to control the direction of the Norwegian krone with monetary policy. The research of Naug and Bjørnland and Hungnes, indicates they can achieve that, at least in times of a relatively stable risk premium. The effect from exchange rates to consumer prices is limited by exchange rate pass-through, which is less than one. Considering exchange rate volatility and Norway's open economy, this sluggishness makes it easier for Norges Bank to hit its inflation rate target. It also seems that the exchange rate react faster to changes in the interest rate differential, than exchange rate pass-through to work its course. This gives Norges Bank time to react to changes in the exchange rate before the full effect materializes in inflation.

2.3 Asset Price Channel

Unexpected changes in short-term interests will all, other equal, move asset prices, most notably equities, bonds and housing, in the opposite direction. People will consume parts of the income from capital gains, which is called the wealth effect.

Case et al (2005) estimates the wealth effect in a comprehensive study consisting of US states during the period 1982-1999 and 14 developed countries, including Norway, during the period 1975-1999. Their estimates use different models so I only report the results in their conclusion. A 10 percent increase in housing prices increase consumption by 1.1 percent for the selected countries, while 0.4 percent for the US. The wealth effect on stock-market gains was not statistically significant. In a more recent paper, Case et al (2011) still do not find any significant proof of the wealth-effect in the stock market. The housing wealth elasticity of consumption is asymmetric depending on whether house prices increase or decrease. They estimate it to be 0.032 in a rising market and 0.1 in a falling market.

Asset price increases would likely also lead to more investment according to Tobin's q-theory, where q is the market price divided by replacement cost of capital. If q is greater than one there is an insentient to increase investments.

Some central banks, like the Federal Reserve and Bank of Japan, have in recent years started to target asset in hopes the wealth effect will promote economic growth. Time will tell if targeting asset prices becomes a significant tool of monetary policy. The results of Case et al (2005) suggest the wealth effect is too small to make a significant impact on economic growth.

2.4 The Narrow Credit Channel

The discussion on the narrow channel is based on Arestis and Sawyer (2002), who cites Bernanke and Blinder (1988) and Hall (2001). This channel assumes that the central bank controls the money supply via changes in bank reserves. Constraining bank reserves will, under this framework, reduce the money supply; hence reduce aggregate demand which will curtail inflation. Norges bank does not have any mandatory reserve requirements for banks, and provide bank reserves on demand from the banking system, Flatner and Tornes (2002). Hence Norges Bank does not try to control the money supply via bank reserves. Banks in Norway are never reserve constrained; however, they are subject to capital requirements. It is plausible that increased capital requirements will result in less bank lending, and reduce money supply.

2.5 The broad Credit channel

This discussion is also based on Arestis and Sawyer (2002), who cites Bernanke and Gertler (1999). This channel is based on asymmetric information between borrowers and lenders. Banks charge lenders a premium to cover monitoring costs. Increased (decreased) interest rate impairs (improves) firms and households balance sheet. Collateral falls in value when asset prices declines, while debt remains constant. When a firm or household balance sheets worsen, banks will increase the interest rate premium to cover increased monitoring costs, or possibly tightening lending standards to the extent that some firms and consumers to no longer have access to bank credit. This will affect consumption and in turn aggregate demand.

2.6 Interest payments on government bonds

Tauheed and Wray (2006) and Bell-Kelton and Ballinger (2005), have considered inflation caused by interest payments on government liabilities. This assumes that there is no crowding out of the private sector, and that the government pays interest with newly created currency. Tauheed and Wray (2006) try to find combinations of debt levels and interest rates necessary so that aggregate demand increase when interest rates increases, and hence inflation. In their model investments is the only factor decreasing aggregate demand when interest rates increases. All public debt is assumed to be owned by domestic households. The marginal propensity to consume out of interest payments is set at 0.9, which according to Case et al (2005), is unreasonable high. In their model inflation can be created by raising the interest rate with the debt ratio of 50 percent and interest rates at 10 percent. Ballinger and Bell-Kelton (2005) claims that in countries where public debt levels are approaching 100 percent, increasing the interest rate will stimulate GDP. This implies that the countries surveyed did not cut other expenditure to offset increased interest rates payments.

A concrete example of this phenomenon is Italy in the mid-nineties. Although Italy had a primary surplus the overall deficit was large due to public debt of 100 percent at GDP and average interest rates on its liabilities of 10 percent. Inflation seemed to have subsided when the central banks lowered interest rates. Levin and Piger (2003), when looking at structural breaks found that Italy's inflation fell in the mid-nineties, against late eighties or early nineties for most other industrial countries.

Public debt in Norway is around 45 percent of GDP and interest rates are currently under 3 percent for 10 year bonds. Interest rates payments in Norway will have a small effect on inflation. In other countries like the US, and

especially Japan, are so high that increased interest rates may create inflation. If other countries get trapped with a low interest rate, this will limit the scope of Norges Bank to set interest rates via the differential between domestic and foreign interest rates.

2.7 Expectation Channel

It is no doubt that inflation expectations are important for future inflation. This seems to be agreed upon among most economic schools. If a central bank is credible it will anchor inflation expectations around the target. If firms believe the central bank can control future aggregate demand as to hit the inflation target that will influence the future expected costs and prices the firms itself faces. The Monetary Policy Committee, Bank of England (1999) points out that investment decisions are made on the assumption of future real interest rates. If inflation expectations is equal to the target real interest rates will move in tandem with nominal rates, giving the central bank control of the real interest rate. Stable inflation expectations will at the same time reduce the probability of a wage-price spiral.

2.8 Empirical Evidence of the Transmission Mechanism

Arestis and Sawyer (2002) survey empirical evidence of the transmission mechanism based on Angeoni et al (2002) and Locarno et al (2001). Their results are presented in the tables below. All coefficients are semi-elasticity multipliers.

Table 3 is calculated by Arestis and Sawyer (2002) based on the research of Angeloni et al (2002). For completeness sake I include the estimated effects on other macroeconomic variables

Table 3. Effects of a one percentage point increase in the interest rate maintained for two years.

	EMM		**AWM**	
	Year 1	**Year 3**	**Year 1**	**Year 3**
Consumer Prices	-0.09	-0.31	-0.15	-0.38
GDP	-0.22	-0.31	-0.34	-0.71
Consumption	-0.12	-0.19	-0.27	-0.54
Investment	-0.34	-1.22	-0.81	-2.96

Source: Angeloni et al (2002), table 2**.**

Notes:

EMM (European Macroeconometric Model) calculations.

AWN (ECB Area-Wide Model) calculations.

Year 1 and year 3 refers to average deviations from baseline.

Locarno et al. (2001) provides estimates from many countries in the European Union in their Annex. Table 4 and 5 are summaries of those taken from Arestis and Sawyer (2002).

Table 4 Effects of a one percentage point increase in the interest rate maintained for two years. Aggregate (Based on National Models)

	2001	**2002**	**2003**	**2004**	**2005**
GDP Deflator	-0.04	-0.20	-0.35	-0.43	-0.41
Inflation*	-0.04	-0.16	-0.15	-0.08	0.02
GDP	-0.22	-0.38	-0.31	-0.14	-0.02
Private Consumption	-0.12	-0.23	-0.19	-0.06	0.01
Investment	-0.34	-1.04	-1.22	-0.80	-0.39
Unemployment	0.04	0.11	0.17	0.17	0.11

Source: Locarno et al. (2001**)**

Table 5. One percentage point increase in the interest rate maintained for two years. AWN Model.

	2001	**2002**	**2003**	**2004**	**2005**
GDP Deflator	-0.10	-0.31	-0.44	-0.57	-0.76
Inflation*	-0.10	-0.21	-0.13	-0.13	-0.19
GDP	-0.34	-0.71	-0.71	-0.63	-0.57
Private Consumption	-0.27	-0.58	-0.54	-0.43	-0.37
Investment	-0.81	-2.37	-2.96	-2.63	-2.42
Unemployment	0.10	0.39	0.58	0.62	0.58

Source: Locarno et al. (2001)

Locarno et al also hints at which of the transmission mechanism that is the most important and states, “The dominant channel of transmission in the first two years--both in terms of its impact on output and on prices--is the exchange rate channel. However, in terms of the impact on output, from the third year of the simulation onwards the user cost of capital channel becomes dominant”.

The Monetary Policy Committee, Bank of England (1999) estimates the effects on inflation after a 1 percentage point increase in the interest rate maintained for one year. Inflation does not seem to react before after a year, while maximum impact is a fall in inflation between 0.2 and 0.4 percentage points after 9 quarters.

Falch and Nymoen (2011) forecast inflation in Norway with a model that has a better track record than Norges Bank's own model. They estimate a 1percentage point increase in the interest rate to lower inflation by 0.115 percentage points, with a standard deviation of 0.024. One percentage point increase in the differential between foreign and domestic interest rates will lower inflation by 0.073 percentage points, with a standard deviation of 0.018.

Even notable inflation targeting critics like Arestis and Sawyer do not doubt the ability of the central bank to influence the inflation rate, or other macroeconomic variables, via monetary policy. Its effect on inflation seems too small to contain inflation if it increased substantially. In such a situation interest rates must be increased to a level that could create a credit crunch. Monetary policy should be able to handle moderate inflationary pressure. Increases in the inflation rate of a couple of percentage points could be fought by increasing the interest rate three to four percentage points, assuming the relationship in the discussion above is linear. Even if Norges Bank seems to be able to contain moderate inflation pressure, it is less likely they will be able to create inflation in a deflationary environment. With interest rates already low there is not much scope to create inflation before interest rates hits the zero bound.

3 Measures of Core Inflation

Measures of core inflation are for the most part derivatives of the CPI, typically some components from the CPI is either excluded and/or re-weighted. Most often one excludes or re-weights volatile components. Especially if they are stationary, in which case experience will suggest the components will revert to the mean. If a country wants to target inflation it needs to decide on which measure, or measures, of inflation to target. In Norway, the central bank targets headline inflation. However, they will still make use of measures of core inflation to guide policy, mainly because core inflation is typically less noisy and is a predictor of future headline inflation. In this section I will briefly discuss different criteria of core inflation from the literature. I will also discuss Norges Banks measures of core inflation. The main reason for this exercise is to check which criteria are used to eliminate or re-weight components. I note that, with a few exceptions, the belief in the omnipotent central bank prevails, since there is no much concern of the ability to the central bank in controlling inflation in each of the components.

Monetary policy in Norway targets headline inflation measured by the Norwegian CPI, KPI. Originally KPI is a Cost-of-Living index measuring monetary compensation required to have the same utility of consumption when prices change over time. Technicalities concerning construction of KPI will not be explored in this paper.

Core inflation tries to capture the underlying trend in inflation. Blinder (1997) defines core inflation as the durable or persistent part of inflation. In this part we will look at different measures of computing core inflation and commonly cited criteria for core inflation. It is beyond the scope of this paper to compare the different measures. Particularly since which measure is the best is also probably country specific, as suggested by Silver (2006). Bulman et al (2004) have

pointed out performance can be advanced if central bankers looks at several measures of core inflation.

The methods of manipulating CPI into a measure for core inflation are outlined by Silver (2006). He groups the methods by those formulated to predict inflation and those suited for policy assessment. The latter group consists of excluding certain components from the core inflation, either permanently or by discretion, so that the index is designed to strip away noise to identify the signal. The reasons for excluding certain components can be to avoid one-off shocks, to focus on domestically generated inflation to remove components in the CPI that are imputed. It is customary to remove the impact on inflation caused by changes in taxes or duties. Other measures for policy assessment are to use trend estimates, median or trimmed means. A trimmed mean will remove a predetermined percentage of the CPI. That is the components with the highest price rises and largest decline is removed. The components are sorted by inflation rate, from largest to smallest. Components are then removed, in the top and bottom, until the weights of the removed components correspond to the predetermined percentage in the trimmed mean. These percentages can be symmetric so the same percentage of the components with the largest and smallest inflation rate is removed, however they can also be asymmetric. The trimmed median is the trimmed mean with 50 percent removed in each tail. Silver (2006) notes that removing noise from the CPI leads to a more predictive measure, and a measure formulated to predict also removes noise.

No consensus exists about the criteria for measuring core inflation, however the criteria of Roger (1998) and Wynne (2008) seems to have gained some traction.

Roger's criteria's can be summarized as the following, measures of core inflation should be:

Robust and unbiased. The measure should be able to separate persistent (expectations and demand-related) and transient (supply-related) inflation. The measure of core inflation should also not be significantly biased relative to the target measure of inflation.

Timely. The measure of core inflation computable in real time, or at the same time headline inflation is published, and not be subject to revisions.

Credible. To avoid suspicion of manipulation by the central bank or the treasury an independent agent should calculate the measures of core inflation used to conduct monetary policy. The same measures of core inflation should be easy for the public to understand.

Wynne (2008) supports those criteria and adds some of his own. He claims that a measure of core inflation should:

Be able to forecast inflation

Have a track record

Have some theoretical basis in monetary theory

Eckstein (1981) was one of the first to define core inflation as: "The trend rate in the price of aggregate supply". He postulated that inflation, π, could be broken down into three components, core inflation,π^c, demand inflation, π^d, and shock inflation, π^s. Hence, $\pi = \pi^c + \pi^d + \pi^s$. Arestis et al (2006) claims this definition indicates that core inflation is largely indirectly determined by money wage growth and raw materials.

Cutler (2001) follows the spirit of Blinder (1997) and creates a persistence-weighted measure of core inflation. She re-weights the components according to their level of persistence, with the most persistent components given the largest

weights and lower weights to the least persistent. The main goal of this measure is its ability to forecast inflation, and less to identify current underlying inflation rate. This shows the benefit of using different measures of core inflation when conducting monetary policy, since a single measure will not tend to outperform the others on the criteria above.

Blinder (1997) suggests excluding food and energy prices because he claims a central bank cannot control the prices of those components with monetary policy. Papadimitrou and Wray (1996) goes one step further and claims that the Fed has limited control over rental prices that determines owner-equivalent rent in the CPI, sharing Blinder's view that such components should be excluded. Silver (2006) believes, however, that it is not obvious that such components should be excluded on the ground that stable overall inflation is important for inflation expectations. Both Blinder and Papadimitrou and Wray suggest that high inflation in one of those components could force the economy into recession. In that case, curbing overall inflation may necessitate deflation in the components the Fed controls, and very tight monetary policy. As we will come back to later, this is also an issue in Norway, which also use imputed rental costs for home owners in the KPI. Further candidates for components which a central bank has limited control over is imported goods, and goods and services where the government sets the price.

3.1 Norges Bank's Measures of Core Inflation

Norges Banks measure of inflation target is the headline KPI. However, they use four main measures of core inflation as indicators for monetary policy. These measures of core inflation are trimmed mean, weighted mean, KPIJAE and KPIXE, Jonassen and Norbø (2006). The main reason to look at these indicators is to help the central bank to avoid reacting to temporarily changes, due to

supply shocks, in headline inflation. All of the measures of core inflation are calculated by SSB, Statistics Norway. The indicators of inflation is found at Norges Bank (2013).

KPIJAE is the KPI adjusted for changes in taxes and exempt energy. The energy components can be found under fuel and electricity in the Housing component and fuel and lubricants in the Transport component. KPIXE is a newer index of core inflation, being calculated since 2008. KPIXE is KPI adjusted for taxes and without temporary changes in energy prices, Hov (2009). The trend of energy prices is estimated in the KPIXE using historical and future prices. Forward contracts for electricity and oil are used to estimate future prices. The trend is smoothed by a Hodrick-Prescott filter. KPIXE is not subject to revision. Over time KPIXE will converge with KPI, as long as there are no substantial changes in taxes. As mentioned the target for monetary policy is KPI, however the other indexes are used to avoid reacting to temporary changes in the KPI. That is, Norges Bank will not react to direct effects on consumer prices due to changes in the interest rates, taxes or temporarily changes in the price level of some component. However, they will not accommodate second round effects. As of June 2013 the computation of KPIXE is altered because it was felt that the trend in energy prices was too volatile. In short they now calculate twelve month increase in the KPIXE as a weighted average of the twelve month increase in the KPIJAE and the twelve month increase in the trend in energy prices. The way to calculate the trend in energy prices have been slightly altered over time.

The weighted median and trimmed mean is constructed as mentioned earlier in the last paragraph. The trimmed mean Norges Bank uses cuts the largest price rises and largest price declines until the weight of the components discarded comprises 10 percent in each tail.

4 Fiscal Policy and Inflation in Norway

Government deficits will have different impact on inflation depending on how they are financed. To establish that point I will go through fiscal and monetary operations Norway. Indirectly the government deficit in Norwegian kroner is financed by selling foreign currency, earned by taxes from the petroleum sector, as opposed to finance the deficit by issuing net financial assets in Norwegian kroner. Until recently Norges Bank's model for monetary policy, NEMO, treated fiscal policy as an exogenous variable, where government expenditures are financed by a head tax, Brubakk and Sveen (2008). This simplification is not necessarily problematic since a central bank does not need to know the sources of inflation to conduct monetary policy. The information they need needed is captured in the measures of inflation and the output gap among others. However, if Norwegian interest rates hit the zero bound, then fiscal policy might be needed to make inflation hit the target.

Norway has a fiscal policy rule, «Handlingsregelen», HR, outlined by the Ministry of Finance (2001). The rule states target for government deficit spending in Norwegian kroner. Explicitly the rule states that each year, government deficit spending, adjusted for income on oil and gas, and should equal the expected real return on Norway's sovereign wealth fund, Statens Pensjonsfond-Utland, SPU, measured at the start of the budget year. The expected real return is 4 percent. With the current size of GDP and SPU Norway can deficit spend roughly 6.5 percent of GDP each fiscal year .The deficit is allowed to deviate from HR to let the automatic stabilizers in the economy work during downturns and discretionary counter-cyclical fiscal policy.

Taxes from the petroleum sector in Norway are divided between its sovereign wealth fund, SPU, and the treasury where it is used to finance the deficit in

Norwegian kroner, Aamodt (2012). The Norwegian government deficit spends in Norwegian kroner, while at the same time save assets denominated in foreign exchange. The Norwegian government has income from the oil and gas sector. This income is mainly from three sources, sale of the government own production of oil, SDØE, their share of the dividend by the partly private owned Statoil and taxes levied on the oil companies operating in the Norwegian sector. Income from the former source is already denominated in foreign exchange, but the two latter sources are paid in Norwegian kroner. The oil companies, of course, have most of their income in foreign exchange and must obtain kroner to pay their taxes. Norges Bank, on behalf of the government will in turn buy foreign exchange in the amount of the surplus of the government budget. The foreign exchange is transferred to SPU, which invests in stocks, bonds and real estate abroad. The government's total cash flow from the petroleum sector is subsequently divided between SPU and finance for the budget deficit, corrected for the former cash flow. Note that the end result on the participant's balance sheets would be the same if all cash flow from the petroleum sector where paid in foreign exchange, then Norges Bank change some of it for Norwegian kroner to finance the budget deficit, while shipping the rest to SPU. In either case the central bank net buy Norwegian kroner. Presumably this will lead to, all else equal, to gradually strengthen the Norwegian kroner against other currencies. The mechanism for financing the deficit in Norwegian krone also acts as a mechanism for transferring government's income from oil and gas to the private sector. The benefit being that the krone is stronger than it otherwise would have been, hence higher international purchasing power for Norwegian consumers.

Instead of solely relying on financing the deficit in Norwegian kroner the treasury could finance parts or all of it by issuing financial liabilities in its own currency. That is, if it wants to create inflation. If deficits crowd out private investments by lending from the private sector one might argue that deficits are

not inflationary. This will not be the case in Norway. Norges Bank controls the short-term interest rate by providing liquidity to the banking system to make sure it always has surplus reserves in the aggregate and by paying interest on these reserves, Fidjestøl (2007). By paying interest on reserves Norges Bank creates a floor on the interest rate in the economy. Bank reserves are, among others added, by government spending and drained by taxes. Likewise there will be a reserve drain when the government borrows money from the private sector. Norges Bank provides reserves on demand from the banking system so this operation will be offset by a liquidity injection if needed. Analytically the result would be almost the same if the government borrowed directly from the central bank, the difference being that the private sector would have bank deposits instead of government bonds after deficit spending. Since the banking sector does not lose reserves after the government lends money, it does not affect their ability to make loans to the private sector. When the government spends money it has borrowed it creates net financial assets for the private sector.

It is not clear how inflationary government deficit spending is. Catão and Terrones (2003) find strong positive association between deficits and inflation among high-inflation and developing country groups, but not among low-inflation advanced economies. The relation is probably not linear; however, if the deficits become "large" enough one would believe it should be inflationary. It is also possible that a situation arises where the deficit must be much larger than the deficit prescribed in HR to sustain GDP. In this case one can have large deficits without it causing inflation because it is offset by increased savings in the private sector. Deficit spending in Norwegian kroner will have two effects, inflation due to extra demand and the effects on the exchange rate. In Norway's case there would be a difference if it changed the composition of how to finance the deficit by selling foreign currency and issuing assets denominated in Norwegian krone, with the latter option being presumably more inflationary

than the former. The added demand could potentially crowd out investment if the central bank reacts with higher interest rate. If inflation is already below the target, this will likely not happen.

It is possible that Norway enters a period of low economic activity and a strong krone at the same time. The low activity will likely cause the deficit in Norwegian krone to expand, with the risk of exchange rate appreciation. During a crisis it is possible that the krone will take a hit as it has done in the past, but after the dust have settled the krone usually appreciates after the risk premium goes down again. In such a scenario it is possible that monetary policy is not capable to hold inflation at the target being that deflationary forces are too strong. In such a situation one could finance parts of the deficit in Norwegian kroner. If the banking system is structurally in surplus versus the central bank, the treasury will borrow from the public sector; otherwise it will indirectly borrow from the central bank via the banking system. One proposal is to peg the amount financed by foreign exchange and let the deficit in Norwegian krone adjust to the business cycle. Then the treasury would have complete control over the deficit in foreign exchange. At the same time the deficit would be allowed to close, or go into surplus, since a deficit in foreign exchange could be offset by a surplus in Norwegian kroner.

5 Components of the CPI

The components of the CPI and their corresponding weights as of September 2013 are as follows:

Component	Weight measured by %
Food and non-alcoholic beverages	13.17
Alcoholic beverages and tobacco products	4.14
Clothing and footwear	5.37
Housing, Electricity and Fuel	22.22
Furniture, Appliances and Household Goods Repair	5.84
Healthcare	2.89
Transport	14.86
Postal and Telecommunications services	2.67
Culture and Leisure	12.72
Education	0.3
Hotel- and Restaurant services	5.18
Other Goods and Services	10.64

I will go through these components and their sub components in order to check monetary policy's likely impact on the components inflation rate. I will focus on the medium-term, which corresponds to the horizon Norges Bank has for the inflation target. The medium-term is about one to three years. Housing will be treated carefully, because of its high weighted contribution to inflation, and since the transmission mechanism do not seem to work as intended on housing.

Norges Bank can influence all components via the parts of the transmission channel that affect aggregate demand. An example would be changes in

investments induced by monetary policy. I will focus on attributes on the components that indicate that monetary policy has moderate impact on their inflation rate, and divide them into categories, which are:

Prices that is partly or fully politically determined

Special taxes or dues on a component

Imputed prices

From the paragraph on the exchange rate channel I have already shown estimates of Norges Banks ability to control components which have a large share of imported goods or services. For exchange rate pass-through for the components I refer to Table 1.

After I have identified the most problematic components I will look at their weighted contribution to headline inflation. I find that much of the contribution to inflation have come from components where Norges Bank have limited control. This raises the question whether they belong in the measure of the target or indicators for inflation targeting.

All statistical material in this section is taken from Statistics Norway, as well as information of components and sub-components. I have also used material from Statistics Norway (2001).

5.1 Food and non-alcohol beverages

Prices of food in Norway are partly determined by domestic policies, Sand and Støholen (2008). Food production in Norway is protected from foreign competition by tariffs. The government and farmer associations negotiate for target prices for agricultural products to be in effect for each year. In turn prices will also be affected by negotiations between food processors and supermarket

chains. International prices for food will influence prices in Norway mainly through two channels. First, some products are not produced in Norway, hence will be imported at world market prices with low, or no tariffs. Also, if domestic price determination causes the price to exceed the negotiated target price, imports will be allowed to press the price back to its target. The contribution to inflation from imported food is relatively small. During 2012 the value of the food and non-alcoholic beverages was 143.2 billion kroner, while import was 32.8 billion. Prices, and hence inflation, of food and non-alcoholic beverages is then partly determined by the government. The consequence being that food prices in Norway is some of the highest in the world. At the same time it causes volatility to be lower than in most countries. This is the reason for the component of food and non-alcoholic beverages being included, unlike most countries, in Norges Banks measures of core inflation. Since some of the food is imported a stronger krone will reduce inflation, all other factors equal. I conclude that domestic policies partly determine the prices paid to the farmers, which transcend into retail prices, although not necessarily one –to-one because the market for food in Norway is highly concentrated.

5.2 Alcoholic beverages and tobacco products

Prices of alcoholic beverages and tobacco are mainly determined by the government since both product types have a high tax rate. The total consumption of alcoholic beverages and tobacco during 2012 was 45.011 billion kroner; of which 19.456 billion was taxes. Obviously, taxes increase the price level and not inflation per se, and as noted taxes are excluded from KPIJAE and KPIXAE. However, these products are taxed to discourage consumption and are subject to frequent tax changes. These changes reflect the current political stance of how much the government wants to discourage consumption. Prices will then be set

relative prices on other goods and services, and with a neutral stand one would expect inflation on this component to follow headline inflation. However, that will be a political decision and the inflation of this component will not depend on the interest rate.

Tobacco and wine are exclusively imported as well as most liquor and some beer. The exchange rate could influence prices in the short-term. I would not expect any long term effect since the effects from the exchange rate can be offset by politicians.

5.3 Furniture, Appliances and Household Goods Repair and Clothing and Footwear

I will treat these two components combined. The direct effect on these components will be how monetary policy influences the exchange rate, and the subsequent pass-through to consumer prices. According to the estimates in Table 1the exchange rate pass-through of these components are the largest in the sample with the exception of cars.

5.4 Housing, Electricity and Fuel

This component is comprised of several subcomponents. The most important is, with weights as of august 2013

Component	Weigth in CPI as % of total
Renters rent	3.12
Renters rent, cabins	0.38
Home owner's equivalent rent	12.57
Imputed rent, cabins	0.29
Electricity, including grid rent	3.8
Fuel	0.32

The main focus will be on the component of home owner's equivalent rent. Norway uses home owners' equivalent rent when computing KPI, following a methodology similar to the US. Acquisition of dwellings is considered investment, while rent is considered consumption. To compute the CPI rent is estimated for renters and imputed for home-owners. That is, impute the rent the home would be rented for in the free market. It is mostly agreed upon that an inflation index should ideally contain only components which are the product of monetary transactions. Indeed the ECB uses Harmonized indices of consumer prices when conducting monetary policy, excluding the housing sector. This is partly since housing markets differ from country to country because of regulation, home-ownership ratio among others. The most common alternative to imputed rent is user-cost. However, since the interest rate is both included in user cost and the goal for monetary policy, inflation will increase directly when interest rates increase. Hence this measure will not be suitable under the regime of inflation targeting. The problem with imputing rent is in Norway, as in the US, that the rental market is small compared to the home-owner market. The

two markets differ in composition of the dwellings, such as size, household size and type of dwellings. We will also look into the transmission mechanism from monetary prices to the rental market, the extent Norges Bank can actually impact rental prices through monetary policy, and with which lag. Rental prices is partly detached from house prices, the latter important for residential investment. A closer look at the housing component will show that it is possible that a rise in interest rates may lead to higher inflation, and hence higher interest rates .One can conclude that owners' equivalent rent may be well suited for a cost-of-living index, but less so for a inflation target.

Nesbakken (2008) notes that there are huge differences between renters and owners in the characteristics of households and the dwellings they live in. This makes it hard to know how the accuracy of home-owners imputed rent. Low income groups tend to be overrepresented among renters. The smaller the household, the more likely it will be a renter. Younger people are also more likely to rent. Home-owners tend to have larger homes than renters. In Norway the market for renters differs not only in characteristics, but is also rather thin compared to the market for home-owners. To estimate owners' equivalent rent SSB uses location, size, type of dwellings, surroundings, number of rooms, and quality of the dwellings amongst others. The result also depends on the methodology for the weights for owners' equivalent rent. All this makes it difficult to impute owners' equivalent rent; however, I have no reason to believe that the estimates are not fairly accurate. The use of imputed rent in an inflation index can still of course be judged on a matter of principle. We will conclude that it is problematic, but still is dwarfed by the potential problems arising from the transmission mechanism.

The transmission mechanism from monetary policy to the housing component of CPI inflation is not clear. For housing the mechanism is clearer. Sørensen and

Whitta-Jacobsen (2010) notes that supply of housing is fixed in the short run, hence prices are determined by demand. The factors determining demand is income, the real interest rate and expected appreciation, with the two latter probably the most volatile. If prices are above replacement cost we would expect over time investments in housing will increase supply. As we have seen, this is an important component of the volatile investment component in GDP and a leading indicator for the business cycle. According to Case et al (2005) there is also a strong wealth effect from housing prices, more so than for other asset classes, like stocks, which further contributes to aggregate demand. Considering how the housing component of the CPI is calculated, it is only those secondary effects on housing prices that will influence inflation via increased aggregate demand. Rents are partly detached from the development in housing prices. I will explore the possibility that monetary policy do not influence rentals in the desired direction, at least not in the medium term.

Papadimetreou and Wray (1996) give some examples of how the transmission mechanism works in the case of the housing component. First they note, “that the transmission mechanism of monetary policy operates to a great extent through the housing sector: higher interest rates raise construction finance cost and reduce supply, while higher mortgage rates discourage demand. As the housing sector slows, so does the whole economy”. However, they note that the housing component of the CPI, which will be the case with KPI as well, do not capture inflation in the housing sector as measured by house prices. They claim that this would not be a big problem if the housing component was a small part of the CPI, but as in Norway it is a relatively large part, and as in Norway accounts for much of the weighted contribution to the CPI. They also note that it is possible that a limited supply of rentals relative to demand, the rental price of single-family detached housing rises rapidly, which would lead to a high rate of inflation for residential and imputed owners' equivalent rent. Also, that this can

occur independently of changes in price of those houses, and of quantity, or cost of current construction of such housing. This would lead the FED to tighten monetary policy, which could cause those considering buying such homes to postpone the purchase because of higher interest rates. This would force them to rent, putting upward pressure on the price of rentals. Tight policy then leads to higher inflation, and hence, higher interest rates. Landlords in turn might try to pass on higher interest costs on the tenants. The authors are aware that this is not a sustainable condition, and in the end something has to give. However, it illustrates possible problems arising from the housing component of the CPI.

They also gave an early warning of what could happen in a speculative boom, while at the same time the rental market is not particularly congested. They claim that such a situation would warrant tighter monetary policy to curb rapid increasing prices of new and used houses. And note that, "the inflationary pressures in the housing market will not be captured in the CPI until the normal rate of transition of detached housing from owner-occupancy to rental plus the normal rate of turnover in the rental market (due to construction of new units and razzing of old units) led to higher rental prices or until bottlenecks force prospective homeowners into the rental market". They believe that there is a link between monetary policy and the housing sector, mainly due to the impact of interest rates on new construction and of mortgage rates on housing demand. These links is such that actual cost increases will translate into inflation rates in an indirect manner. They conclude that there is no reason to suppose that inflation as measured by the CPI accurately reflects market conditions for owner-occupied housing. We note that this description is not that far from what has happened in Norway and other developed countries, in the years after their article was written. In Norway prices for apartments and houses are at an all-

time high, after a strong rebound after house prices fell during the height of the financial crisis.

The subcomponent of Electricity and grid rental is, as the component of fuel, rather volatile. Hence it is excluded from KPIJAE. The price of grid rental is determined partly by the government. It is supposed to cover the costs of the electricity companies building and operating their grid, as well as allowing them some profit on their capital. The grid rental is calculated in three steps. First the government decides the income to the company that owns the grid. Then the company estimates the consumption of their customers in Kwh. Finally one divides to find grid rental per Kwh. If the estimate proves to be wrong, the grid rental is changed so total income corresponds to the value in step one. Grid rental is independent of consumption so if consumption is low grid rental increases, and vice versa. That implies that grid rental increases volatility in prices, conditioned that lower consumption is caused by lower production. This is an example of politically determined prices which the central bank has no direct control over. In fact, prices of grid rental will increase when interest goes up because it raises the cost of capital.

5.5 Healthcare

The subcomponents of Healthcare are medical products, glasses, medical services, paramedical services and dental services outside of institutions. Healthcare in Norway is mainly publicly financed. Hence most of the prices of healthcare consist of politically determined prices. Costs to the consumer of medical services and medical products are user fees. For medical products the

consumer pays full prize, however, after a certain expenditure threshold have been reached the patient will pay a user fee for the rest of his consumption.

5.6 Transport

As with the component for housing the characteristics of the subcomponents of the transport components are have a different nature. Most notably, as the housing sector, it consists of an energy component. For that reason I will also decompose this component into its parts and corresponding weights as of August 2013:

Component	**Weigth in CPI as % of total**
Cars	4.79
Motorbikes	0.26
Bikes	0.26
Spare parts and accessories	0.56
Fuel and lubricants	2.91
Maintenance and auto repair	2.27
Other Services connected to private use of transport	0.95
Passenger travel by train, metro or electric tram	0.37
Passenger transport by road	1.09
Passenger travel by air	0.77
Passenger travel by boat	0.56

Cars and motorbikes are exclusively imported; hence their price depends on the price of the Norwegian krone and on pass-through. Cars have the largest pass-through of the sample in Table 1.

Fuel and lubricants are, as mentioned, excluded from the core inflation measure KPIJAE because of its volatility.

Passenger travel in Norway will in most cases be subsidized and regulated by public authorities. Sometimes private companies compete for public contracts, or the public sector will provide the services by themselves. Nonetheless, the price paid by the consumer will usually not cover the true cost of the service.

One subcomponent of particular interest is passenger travel by air because of its high volatility. In 2007 SSB made a change in the methodology that caused volatility to increase dramatically. In short, as described by Johansen (2007), airliners sell tickets based on different booking classes, which have different prices. Each class has its own base rate. Before 2007 SSB tracked the change price in the base rate, however this is only correct if the different classes differ in quality. The categories that would obviously differ in quality are if the tickets are flexible or non-flexible. SSB tracks non-flexible tickets, since that are the choice of most consumers. There are, however, several booking classes within those two categories, which only one is available at a point in time that have a different base rate. Since the CPI is supposed to reflect what consumers actually pays for goods and services SSB decided to change their methodology, withstanding the higher volatility. To take into account the changing prices SSB started to track prices for each flight three months in advance, then gradually following up with shorter intervals as time passes. Because of the high volatility this subcomponent can heavily influence CPI inflation even though its weight is relatively small with 0.77% of the total. As a side note, even if energy is excluded from measures of core inflation they still influence prices in a variety of products. Derivatives of Petroleum are found in the strangest products, so

even if energy is excluded costs, and presumably prices will, be affected by changes in the price of oil. This is particularly obvious in the case of flights, since fuel is a large cost for airliners.

5.7 Postal and Telecommunications Services

The Postal Office in Norway has a monopoly in delivering letter and packages subjected to limitations in price and weight. The prices the Postal Office wants to charge must be approved by the government. Prices are then determined by the state. The weight is rather small; the most recent weight is only 0.07%.

5.8 Culture and Leisure

This component consists of 17 subcomponents, so even if the main component has a current weight of 12.72 percent each of the subcomponents are rather small. I will only focus on a few of them which are particularly interesting.

Two of the subcomponents consists of audio visional and IT equipment. Most of which is imported.

Books are a small component of KPI, currently only, 0.66% of the total. However, after SSB changed its methodology for books in 2007 to get in line with guidelines from Eurostrat, volatility have increased to an extent so this subcomponent have the potential to massively influence headline inflation. The technicalities are somewhat tedious and will not be explored in detail. Suffice to say that one of the reasons for the volatility is increased seasonality in prices. SSB divided the books into different categories; within the categories they

compare price changes from month to month, where the selection within each month varies

5.9 Education

This component consists of politically determined user fees for public education and costs of private education. The latter carrying most weight in this component.

5.10 Hotel- and Restaurant services

This component is labor intensive and hence will likely track inflation of wage growth.

5.11 Other Goods and Services

This component consists of several subcomponents ranging from Haircuts and Beauty Care, Social Care and Insurance, Financial Services and Toiletries as the most important. Hence the characteristics of the subcomponents are quite different.

Haircuts and Beauty Care is labor intensive would likely have inflation tracking wage growth. We also note that Social Care, which among other consist of user fees for children in kindergarten. This is another example of politically determined prices.

5.12 Conclusion

Books and Passenger travel by air should be considered to be excluded from the measures of core inflation because of their volatility. However, they will be likely candidates to be removed from the trimmed mean, and hence, the trimmed median as well. If their weights were larger I would guess they would be removed from all measures of core inflation.

Home owner's equivalent rent and imputed rent for cabins combined accounts for 12.86 percent of KPI. We have seen that beside of the methodological problems with imputed rents, monetary policy might not influence these components, or in the worst case inflation of these components might rise in tandem with the interest rates. I will again emphasis that over the long-run the central bank will affect all components. When I have written that Norges Bank cannot influence the components it is meant to be understood over the medium-term

Prices largely controlled by the government consist of about 10 percent of KPI. Food and non-alcoholic beverages combined with Alcoholic beverages and tobacco consists of 17.41 percent of the consumer price index.

In the short-run one could assume that exchange rate volatility is beyond the control of the government. This affects a large part of KPI, however, the effect on consumer prices is muted by slow exchange rate pass-through.

6 Weighted Contribution from the Components

Papadimetrou and Wray (1996) recommended excluding components beyond the control of the central bank as a measure inflation target. The reason they

suggested excluding those components is because if most of the inflation originates from such components the central bank must use tight monetary policy to ensure inflation is low enough in the components they can control to hit its overall target. This they claim will hurt the economy. If inflation in components the central bank controls were high, it could be conceivable that that monetary policy could be too loose. They do not consider this scenario; probably because they seem to believe that moderate inflation below 8 percent do not hurt economic growth. I will also check if the components that Norges Bank can control have decreased in importance. I find that in the eighties most of the contribution came from the goods sector, but now stems mostly from the service sector. Monetary theory suggests that interest rate changes impact the goods sector more than the service sector. The contribution from the Housing sector has increased a lot over the years as well.

I have calculated the weighted contribution to inflation from each component. The weighted contribution is found by taking the one-year change of the index for each component, multiplying by the appropriate component weight, and dividing by the change of the overall KPI. I have calculated inflation in each component and KPI by using their respective indexes from December to December each year. The weights were changed in August each year until 2009 complicating the procedure somewhat; the method is explained by Statistics Norway (2013). I have calculated the weighted contribution from each component of the KPI and the delivery sector since 1980. Selected components are presented in Appendix D. Ideally I would have taken out all the components in KPI that is imputed or politically determined. Unfortunately this is not possible because I do not have access to the weights and indexes for all of the subcomponents.

Figure 2 to 5 are taken from the KPI for the delivery sector. I note from Figure 3 that the goods sector has declined in importance. Figure 2 indicates that some of

this effect is due to appreciation of the Norwegian krone. Norges Bank can control the exchange rate as shown, at least to a certain extent. From Figure 5 it seems like the contribution from domestic produced goods have declined somewhat in importance, also the contribution has become more volatile. The weighted contribution from rent and imputed rent has shown a steady increase, especially after inception of inflation targeting.

Figure 2. Weighted Contribution Imported Goods and Domestic Goods and Services

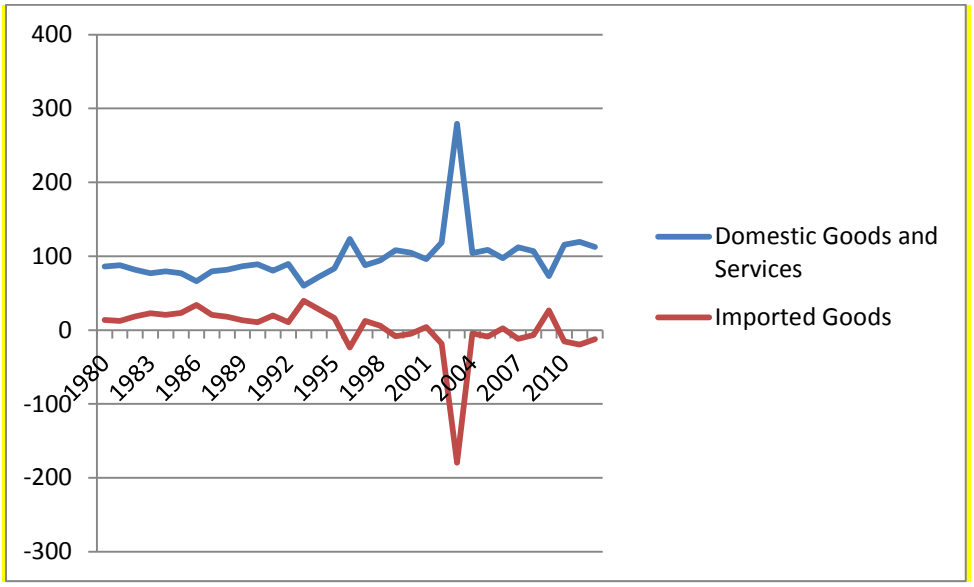
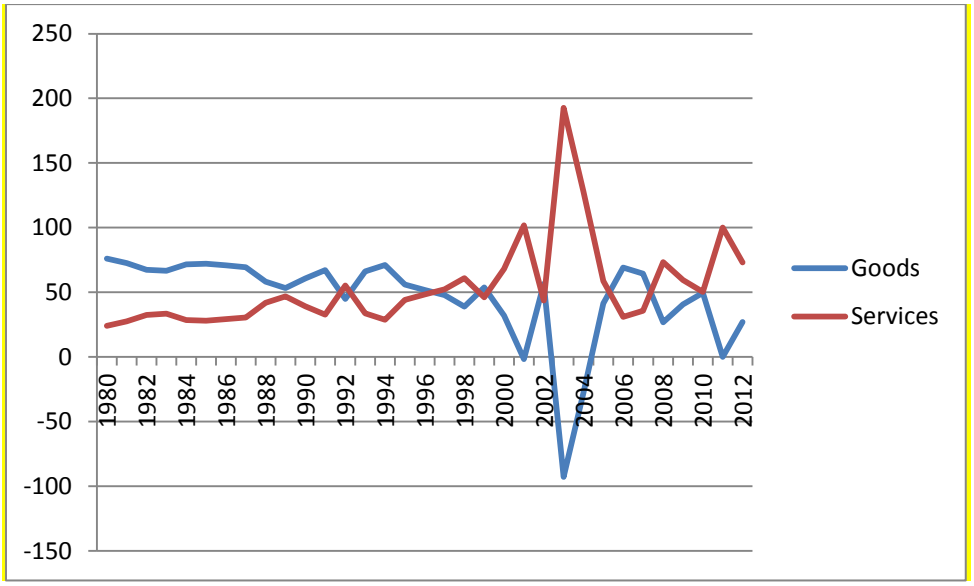


Figure 3. Weighted Contribution Goods and Services



Note: For 2011 the contribution from the service sector was 563 percent and 463 percent from the goods sector. I have set 100 for the service sector and 0 for the goods sector for that year.

Figure 4. Weighted Contribution Rent and Imputed Rent, Including Vacation Homes

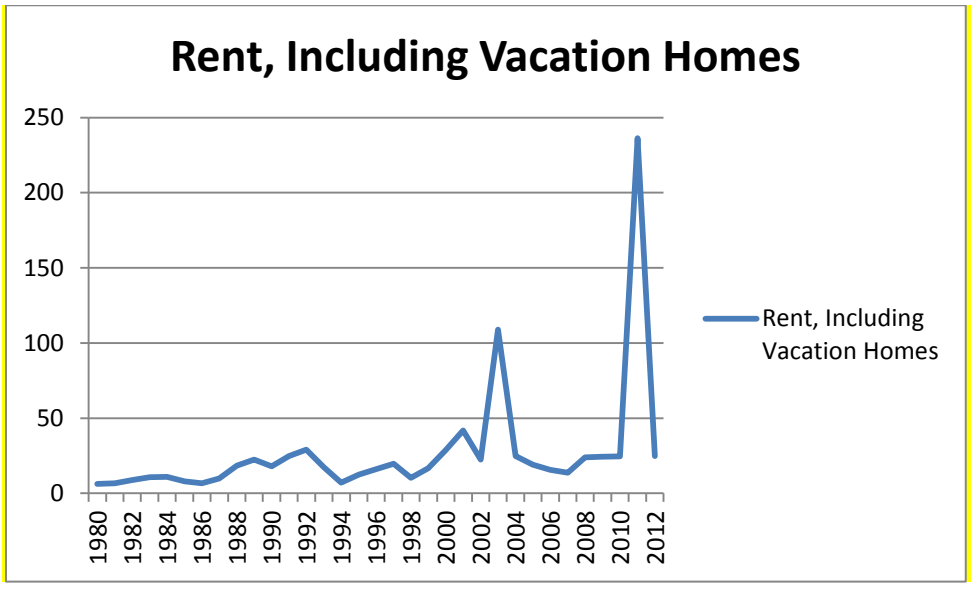
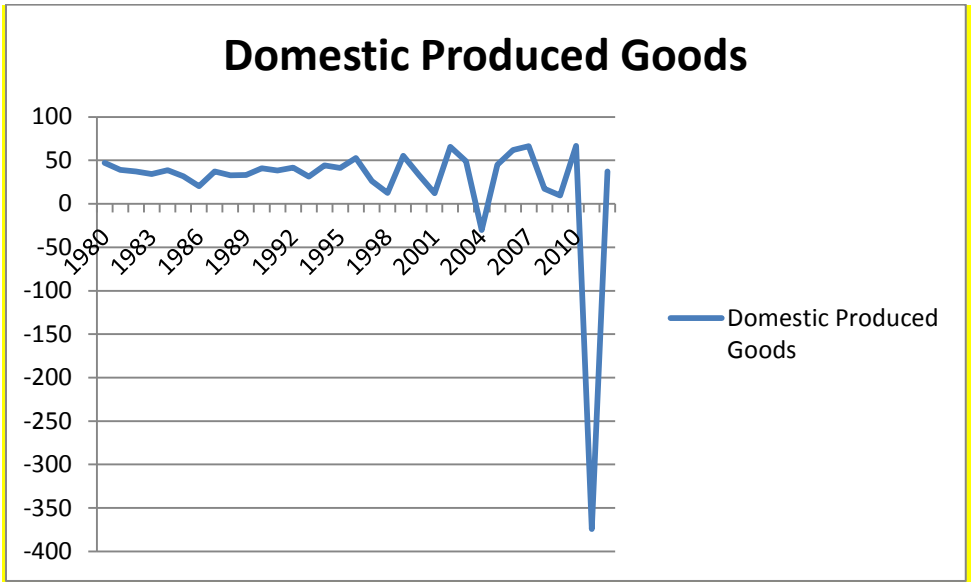
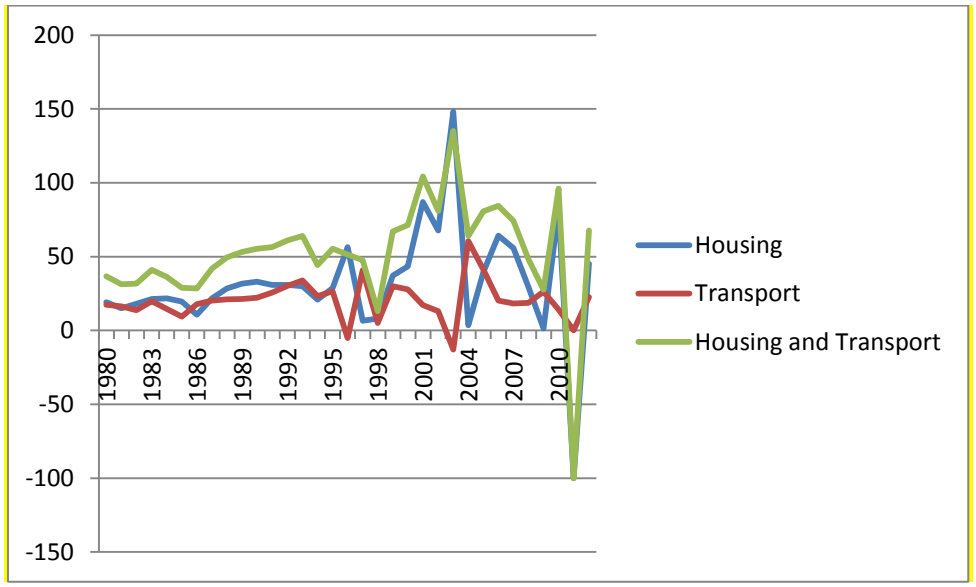


Figure 5. Weighted Contribution to inflation from Domestic Produced Goods, except Fish and Agricultural Products



The weighted contribution from the Housing and Transport components have steadily increased over the years and after 1999 tends to dominate headline inflation. I have shown that Norges Bank have limited influence over the Housing component and largely controls the Transport sector via its influence over the exchange rate.

Figure 6. Weighted Contribution to inflation from the Housing and Transport Sector



Note: The weighted contribution from the Housing and Transport component was -443 and 98 respectively in 2011. I set that to -100 for the scale to not blow out.

Looking at Table X I note that headline inflation has been below the target on average. This indicates tight monetary policy for at least parts of the period. Had it not been for inflation from the Housing component inflation would have been lower still.

Table 6. Average Inflation for the components over the period January 1999- June 2013

Components	Inflation
Education	4,01
Alcoholic beverages and tobacco products	3,76
Housing, Electricity and Fuel	3,46
Hotel and Restaurant services	3,29
Other Goods and Services	2,67
Transport	2,66
KPI	1,98
Food and non-alcoholic beverages	1,46
Culture and Leisure	1,08
Furniture, Appliances and Household Goods Repair	0,27
Healthcare	-0,01
Postal and Telecommunications services	-2,87
Clothing and footwear	-4,36

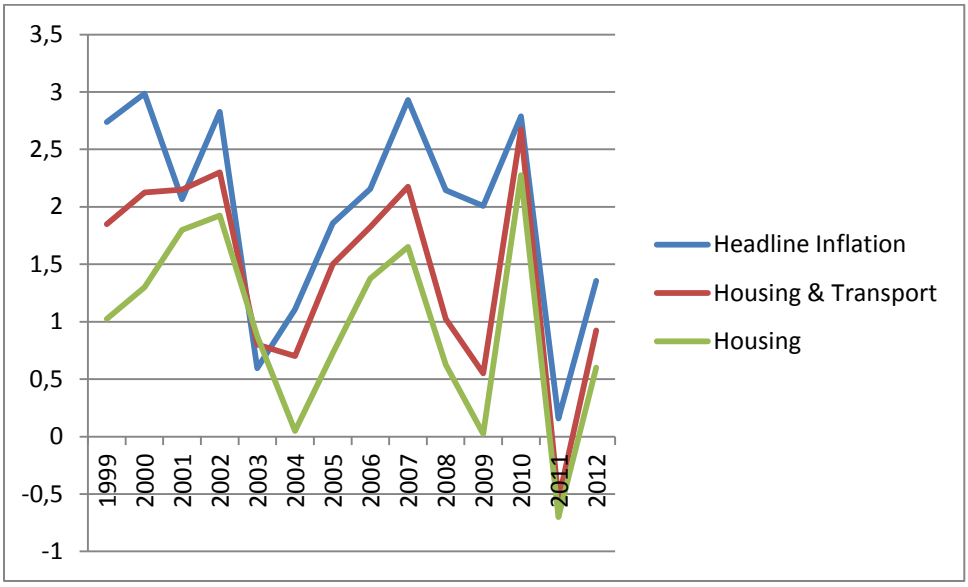
Source: Indexes taken from Statistics Norway, based on my own calculations.

Over the period Postal and Telecommunications services and Clothing and footwear have experienced deflation. This is most probably not because of tight monetary policy. The main reason for the fall in prices Postal and Telecommunications services is technological improvements. For Clothing and footwear the main reasons are shift in imports from low-cost producers, competition among retailers and abandonment of tariffs and quotas. Changes in relative prices are not prohibited under inflation targeting. This is normal in a well-functioning capitalist economy. I would be reluctant to claim that deflation in parts of the components has been a problem under inflation targeting. However, parts of Papadimetrou and Wray's critique are valid because tight monetary policy seems to have been masked by a rise in components the central

bank has limited control over. Most notably the Housing component, but also Alcoholic beverages and tobacco products and to some extent the Transport sector.

The method by Papadimetrou and Wray has some drawbacks. First of all it is not defined when headline inflation is zero. Second, if headline inflation is very low, some of the components can have very large weighted contribution without necessarily having inflation being out of line. I note from the figure that except for 2008 and 2009 the Housing and Transportation components for the most part determined headline inflation.

Figure 7. Headline Inflation and the contribution from Housing and Transportation sector



As noted Norges Bank controls parts of the Housing component and the Transport component mainly through the exchange rate channel. The figure still warns of what could happen in the scenario described in the paragraph of Fiscal policy, a situation with low economic activity combined with a strong krone. In such a situation it is conceivable that rent increases stall for a period. Figure 7 suggests strong deflationary pressures would be likely.

7 Monetary Regimes in Norway over the period 1979-2013

In analyzing inflation it makes sense in looking at periods with different monetary regimes separately. A central bank deserves to be judged on its conduct based on its objectives at the time. It is also interesting to compare level, stationary and persistence of inflation in light of regime shifts. Another possible approach is to look for structural breaks in inflation. Even if it would be interesting to see if they would correspond with the regime changes, I have chosen not to do so. This is because I believe that structural breaks mostly are determined by international factors, forces strong enough to triumph domestic policies. Suffice to say that events from abroad seem to have influenced domestic inflation rates, which in turn have influenced the corresponding regime change.

I will divide the monetary regimes into four periods. The discussion below is based on Klunde (2011). Norway devalued for the last time on the 10. December 1992 and it marked the end of fixed exchange rates in Norway. The period of fixed exchange rate will be divided into two periods. Before the fall of 1986 the interest rate was determined politically by the treasury. However, ever since, Norges Bank has determined the short term interest rate. This decision was prompted by the devaluation of 1986. The treasury had a history of setting the

interest rate so low that intervention in the foreign exchange market was necessary to defend the targeted value of the Norwegian krone. In 1986 these interventions became too costly, while at the same time falling oil prices added pressure on the krone. The subsequent transfer of power to determine interest rates to the central bank was made to put relief on the central banks foreign reserves by relying on the interest rate to defend the fixed exchange rate. Formally the krone was pegged to a trade weighted basket of foreign currencies from December 1978 until October 1990. From October 1990 until December 1992 it was pegged to the ECU.

After the devaluation of 1986, Norway did not devalue again until December 1992. This meant the end of fixed exchange rate for the Norwegian krone. Formally the krone floated from December 1992 until May 1994. During this period it was intended to re-peg the krone as soon as international conditions would permit, but that never happened. From May 1994 until March 2001 Norges Bank was supposed to keep the krone stable against a basket of European currencies, using interventions if necessary. Using the target of the peg it abandoned in 1992 as the focal point. This was relatively successful, as the krone was quite stable over the period. The period from January 1992 until December 1998 can be characterized as a dirty float, where they tolerated swings of 15 percent from the target.

I will still consider the krone to be floating during that time, since there was not any explicit target for the exchange rate of the krone. It could be interpreted that if the krone had been severely tested, Norges Bank would not have defended the krone with any pervasion. Instead the central bank was looking for the krone to return to its past value after the dust settled. I have chosen to divide the period with floating exchange rate into two periods, before and after inflation targeting.

The inflation target was officially introduced in March 2001, however, for practical purposes it can be argued that Norway de facto introduced inflation

targeting with the appointment of Svein Gjedrem as the head of Norges Bank in January 1999. Gjedrem was a firm proponent of inflation targeting. He believed that to achieve the goal of a stable, yet floating, krone against European currencies Norwegian inflation needed to converge to that of those countries, Gjedrem (2000). While hardly controversial, this marked a regime shift in the sense that interest rates became the sole instrument for the central bank, even before inflation targeting was officially introduced in March 2001. This is illustrated by the fact that the central bank ceased to intervene in the foreign exchange market after January 1999.

During the first period, the treasury would determine interest rates. The interest rate was, as mentioned, set effectively too low to defend the exchange rate. As one would suspect monetary and fiscal policy could be to accommodate inflation to satisfy popular demand. To regain competitiveness Norway devalued several times during this period, either outright as in 1986, or by changing the weights in the basket of currencies in the peg. This indicates that inflation was too high compared with the countries in the peg. The depreciation of the krone would further increase the rate of inflation. In such a regime one would guess inflation expectations to be rather high. When a country pegs its currency to other currencies it loses a lot of freedom in setting interest rates and pursuing fiscal policy. As commonly known, over time the country can have no higher inflation than the country, or countries, which its currency is pegged to. That is, it can as long as it has foreign reserves. We would expect that during this period of relatively accommodative policies, that inflation persistence would be quite high and inflation possibly to have been non-stationary.

After Norges Bank was given the task of defending the exchange rate of the krone through the use of the interest rate one would expect inflation to subside. That is relatively to the previous regime, taken developments of foreign inflation into account. A burst of inflation from abroad would probably have led to higher

inflation in Norway as well. However, one would expect domestic inflation to converge to that of the countries in the currency basket. As the central bank would presumably crack harder down on inflation threats, one would expect persistence to be lower and inflation to be stationary, compared to the previous period. That should be true regardless of the level of inflation. KPI inflation fell from 8.4 percent to 4.5 percent from the first to second period, data is found in Appendix E.

After the krone started floating in the third period inflation fell further to slightly above 2 percent. This fall would probably not have occurred had it not been for fall in German inflation of that period. For all the first three periods domestic inflation in Norway would be contingent on foreign inflation because of exchange rate and monetary regime, where Germany being the most important country. It is only in the last regime of inflation targeting that domestic inflation can be allowed to deviate from foreign inflation without eventually leading to the collapse of the regime. Obviously, domestic inflation is meant to deviate from foreign inflation in the case the latter deviates from the inflation target.

8 Persistence and Unit Roots in Inflation

If a central bank successfully targets inflation, implicitly or explicitly, then inflation should be stationary around that target, hence have a unit root. Inflation persistence determines the speed which inflation returns to its mean, or equivalently, how permanent or temporary are shocks to inflation. Under inflation targeting the means corresponds to the target. If inflation contains a unit root, it will not have a tendency to return to its mean. Hence, that inflation does not contain a unit root is a prerequisite for inflation targeting to succeed,

and inflation persistence measures the lag, or speed, in which inflation return to its mean. If the central bank is having control over the rate of inflation, headline inflation should be stationary around the target, combined with low volatility. The absence of a unit root, however, is only a necessary, not sufficient, condition to conclude a central bank can control inflation via the interest rate. This is because other explanations for stationary inflation are possible. I have checked if the components of the Norwegian CPI index, as well as the aggregate index, are stationary. This is to indicate if there are components that are non-stationary, indicating that Norges Bank may have limited control over those. If the time series of an index is non-stationary it is following a random walk. This should not be interpreted as if fiscal and monetary policy cannot influence this component in the long run. Inflation cannot increase independently of policy giving a boost to aggregate demand or is accommodative towards supply shocks. However, Norges Bank targets inflation over the medium term, approximately two years. If a component contains a unit root this implies that Norges Bank cannot influence the component during the target period. One would guess that monetary policy can become tight enough to influence all components; however targeting non-stationary components will probably mean that the components already stationary will undergo severe deflation in such a scenario. I will also look at inflation persistence for each of the components and in the aggregate. Further I will divide the period from 1978 until today into four different time periods, motivated by changes in monetary regimes suggest by the previous paragraph.

I will start out with definitions of inflation persistence; continue with measures of inflation persistence and unit root tests. I will follow up with a short discussion of research of inflation persistence, including international experiences with inflation persistence during different monetary regimes. To conclude I provide my own results of inflation persistence and unit root tests in

Norway. The results show inflation persistence to have fallen over time. Under inflation targeting most of the components are stationary, as well as in the aggregate. This indicates that inflation targeting has been largely successful in bringing down. I attribute this success to anchoring of inflation expectations.

8.1 Definitions and Measures of Inflation Persistence

Fuhrer (2009) points to two types of inflation persistence, Reduced-form persistence and Structural persistence. Reduced-form persistence refers to the empirical property of an observed inflation measure, without economic interpretation. Structural persistence refers to persistence that arises from identified economic sources. He divides these sources into three types:
-those generated by the driving process
-those that are a part of the inflation process intrinsic to inflation (that is, persistence that is imparted to inflation independent of the driving process)
-those that are induced by its own actions or communications.

He argues that no single definitive measure of reduced-form persistence exists. Researches have employed a variety of measures to capture the idea that inflation gradually responds to shocks. This definition implicitly assumes that inflation is positively correlated with its own lags. Some researchers define persistence as the extent to which shocks in the past have an effect on current inflation.

Willis (2003) defines persistence as the "speed with which inflation returns to baseline after a shock.

Batini and Nelson (2002) have three definitions of inflation persistence, which hints to possible measures of inflation persistence:

-positive serial correlation in inflation
-lags between systematic monetary policy and their (peak) effect on inflation
-Lagged responses of inflation to non-systematic policy actions (i.e. policy shocks)

Marques, to paraphrase, claim that these definitions, except the first one, deals with speed of the response to inflation to a shock. If speed is low, inflation is persistent and if speed is high, it is not persistent. An important implication on the above definition of persistence is that any estimate of inflation persistence is conditional on the assumed long-run inflation path. In order to tell whether inflation is moving quickly or slowly in response to a shock, we need information on the path inflation would have followed had the shock not occurred. He claims this has been mostly ignored in the literature, where it is assumed that there is a constant long-run level of inflation when computing estimates of persistence. Marques points to exceptions, for instance Bleany (2001), Levin and Piger (2003) and Burdekin and Syklos (1999), which allows for the possibility of breaks in the mean of inflation. Evaluating inflation persistence amounts to find an answer to the question: how slowly does the inflation converge for the exogenous central bank target in response to a shock?

There certainly other definitions of inflation persistence, however, I trust I have been comprehensive enough to catch its spirit. I will focus this paper on Reduced-form persistence.

Fuhrer (2009) lists a battery of measures of inflation persistence:
-Conventional unit root tests
-The autocorrelation function of the inflation series
-The first autocorrelation of the inflation series
-The dominant root of the univariate autoregressive inflation process

-The sum of the autoregressive coefficients for inflation
-Unobserved components decompositions of inflation that estimate the relative contributions of "permanent" and "transitory" components of inflation.

Marques suggest using half-life of persistence, which have the nice property of giving a time frame to persistence. He defines it as, "The number of periods for which the effect of a unit shock to inflation is above 0.5". As mentioned above one could introduce structural breaks or trends in search for inflation persistence.

8.2 Evidence of Inflation Persistence

In this section I will look at evidence of inflation persistence. I will also look at inflation persistence during different monetary regimes, since this paper separates from different monetary regimes when looking at inflation persistence. I will also concentrate on reduced-form persistence.

Many researchers find that inflation persistence has fallen since the seventies and eighties. Batini and Nelson (2002) find that serial correlation in the US fell from 0.626 in the period January 1965-December 1984, to 0.369 from January 1985 until August 2001. For the UK it fell from 0.525 in the period January 1965 until September 1992 to not significantly different from zero in the period from November 1992 until August 2001. Similarly Kuttner and Posen (2001) find that inflation targeting countries have experienced "large, significant reductions" in the autoregressive coefficient of monthly inflation. Benati (2008) also finds significant reductions in reduced-form inflation persistence in The US, UK, Canada and Euro-Area. CPI inflation persistence fell from 0.77 during the Great Inflation to 0.49 Post-Volcker. In Canada CPI inflation persistence fell

from 0.90 to -0.33 after inflation targeting was introduced. Similar declines happened in the UK and the Euro area.

Other researchers have not found substantial evidence of decline of inflation persistence. The main reason seems to be different methodology, since the researchers have allowed for structural breaks in the mean of inflation. Marques points out that autoregressive persistence assumes constant mean. This makes inflation persistence sensitive to the time period chosen, unless one search for structural breaks in the mean of inflation. Marques argue for a time-varying mean of inflation. Not surprisingly, this will remove most of inflation persistence, even during the period of high and variable inflation as in the seventies. He subsequently does not find evidence of changes in inflation persistence over different periods. Levin and Piger (2004) use structural breaks to look for changes in the mean of inflation. Using CPI, PCE Price, Core CPI and GDP price inflation, most of the countries in the survey had a structural break in the mean of inflation during the early nineties. They find that allowing for a possible break in the mean, many of the inflation series exhibit very little persistence. They conclude that inflation persistence is not an inherent characteristic of industrial economies.

The constraints for monetary and fiscal policy differ depending on if a country currency is pegged or if it floats. If inflation persistence is caused, at least partly, by accommodative monetary and fiscal policies, then a country with a floating exchange rate have larger scope to be accommodative towards inflation. If a country wants to maintain a peg it must be restrictive in monetary and fiscal policy. Hence, one would believe that inflation persistence is more a problem under floating rates. However, most exchange rates on a peg are eventually devalued, implying to loose monetary and/or fiscal policy to sustain the peg.

However, countries with floating exchange rate may have had a tight combination of monetary and fiscal policy as well. Bleaney (2001) claims that there is no evidence that monetary policy is more accommodative under floating rates, and cites Burdekin and Siklos (1999) that claims that changes in inflation persistence has changed for reasons unconnected with exchange-rate regime. He also notes that "the constraints of pegging the exchange rate have the effect of making inflation reflect the dynamics of the reserve currency". Beside different constraints on monetary and fiscal policy under pegged and floating rates, Dornbusch (1982) showed the more the exchange rate accommodated inflation shocks, the more persistent these shocks were. Grytten and Hunnes (2009) have found that there was virtually no inflation persistence, combined with low inflation, in Scandinavia during the Gold Standard dating from 1874 until 1914. Batini (2002) looks at inflation persistence over the period1970-2000 in selected Euro area countries. He separates this period into two periods according to changes in monetary regimes. He concludes that, "The persistence of European inflation seems to have varied only marginally over the past thirty years, despite the numerous monetary policy regimes shifts occurred in Europe after the collapse of the Bretton Woods system".

8.3 Results of Unit Root Test and Inflation Persistence

I have tested for stationary inflation and reduced-form inflation persistence on monthly data for KPI and its twelve components. Ideally, I would have liked to run the tests on KPI-JAE; however, I choose to use KPI because of its longer time-span of data. I have seasonally adjusted all indexes using dummy variables. For the Unit Root test I have chosen the Augmented Dickey-Fuller, (ADF), test, mainly because it is the most commonly used test. As a measure of inflation persistence I have used the sum of the coefficients of the Auto-regressive

function. The time period is from January 1979 until June 2012. Further, I have divided these into four periods dependent on the monetary regimes described in a previous paragraph. I could have looked for structural breaks to see if they would correspond to the changes in monetary regimes. I have not done so because I would be careful with the economic meaning of such a break. Even if it occurred at the same time as the regime shift, it is possible that other factors lead to a structural break, which then prompted a regime shift.

The formula for the ADF test is:

$$\Delta\pi_t = \alpha + \beta t + \gamma\pi_{t-1} + \sum_{j=1}^{p} \delta_j \Delta\pi_{t-j} + \varepsilon_t$$

The ADF test is a regression of the first difference of inflation over a constant, a trend term, lagged inflation, lagged first differences and a serially uncorrelated random error term. I have set β= 0. A trend term would suggest accelerating inflation, while I want to check for stationary inflation around a constant mean. The periods, even when looking at monthly data, is relatively short. This is a potential problem since the ADF test power is low on short time spans. A lot of the disagreement over stationary inflation is caused by researchers using different unit root tests. However, since unit roots tests in general have low power over short time spans and since I compare different time periods, I have decided that the ADF test is adequate. Over short time spans tests will err on the side of rejecting too few unit roots in the series.

I use the method suggested by Campbell and Perron (1991) when selecting lag length, k. The procedure is to set an upper bound for k, k = k_{max}. If the last included lag has a t-value is significant at the 10 percent level, 1,645, choose that lag. Otherwise reduce k by one until the last lag is significant. It is common the use Akakie information criterion or the Schwartx criterion, however Ng and

Perron (1995) have shown that these methods tend consistently tend to choose to small k, especially when the sample size is finite. For k max I have set 18 for the period as a whole, 12 for the first three sub periods and 14 for the last sub period. This is loosely guided by Schwertz (1989), by choosing k_{max} by the integer formula $\{C^*(\frac{T}{100})^{(\frac{1}{d})}\}$ with C= 12 and d = 4. This method is ad hoc, however quite common to use.

I will use the sum of the coefficients, ρ, of the autoregressive function as a scalar measure for persistence. Where $\rho \equiv \sum_{j=1}^{k} \alpha_j$ in the autoregressive function

$$\pi_t = \mu + \sum_{j=1}^{k} \pi_{t-j} + \varepsilon_t.$$

This is maybe the most common measure. Andrews and Chen (1994), even though they advocate this measure, points to some potential problems. Two series could have the same value of ρ, however one of the series could have only positive values, while another could have vales that oscillates between positive and negative numbers. Likewise it is possible that two time series have the same ρ value where one of the series have large initial coefficients followed by a rapid decline, and one series that have smaller initial coefficients, but a slower decline. Marques points out that all measures of inflation that involves ρ will likely have similar problems. For lag length I have chosen p+1, where p is the lag length of the ADF test. Then the p value will correspond to the coefficient of the lagged value of inflation in the ADF test plus one. I will consider the equivalent expression:

$$\Delta\pi_t = \mu + (\rho - 1)\pi_{t-1} + \sum_{j=1}^{k-1} \Delta\pi_{t-j} + \varepsilon_t$$

Then the scalar measure of persistence will correspond to the coefficient in the ADF test plus one. In general, by construction, the aggregate index tends to be more persistent than its components.

Not surprisingly the mean of headline inflation have fallen over the time periods. The inflation rates are summarized in Appendix C. When the treasury controlled the interest rate average inflation was 8.4 percent, it fell to 4.5 percent after the control of the interest rate was handed over to Norges Bank. After the krone started floating inflation fell to slightly above 2 percent, while after the inflation target was introduced it fell further, however insignificant, to slightly under 2 percent.

Details of the unit root tests and persistence can be found in appendix A and B. A short version is shown in this table X. The coefficients are persistence and a star indicates if the component was stationary at the 5 percent level during the period. The components are ranked by the sum of persistence during the sub periods, which is the last entry in table 7.

Table 7. Inflation Persistence and Unit Root tests on components of KPI

Components	79-13	79-86	86-92	93-98	99-13	Sum
Furniture, Appliances and Household Goods Repair	0,85	0,49	0,76	-0,14	0,43	1,54
Hotel and Restaurant services	0,71*	0,50	0,03*	0,80	0,01	1,34
Other Goods and Services	0,72	0,08*	0,51	0,37	0,35*	1,31
Food and non-alcoholic beverages	0,70	0,37	0,64	0,37*	-0,19*	1,19
Housing, Electricity and Fuel	0,39*	0,85	0,92	0,00	-0,66*	1,10
Culture and Leisure	0,81	0,28	0,77	-0,14	0,16	1,06
KPI	0,81	0,73	0,83	-0,17*	-0,50*	0,90
Education	0,26*	-0,04*	0,22*	-0,03*	0,30	0,46
Clothing and footwear	0,77	0,37	0,77	-0,40	-0,43*	0,31
Postal and Telecommunications services	0,57	0,16	0,47	-0,07	-0,34*	0,22
Transport	0,51*	0,59	0,01*	-0,29	-0,47*	-0,15
Alcoholic beverages and tobacco products	0,40*	0,26	-0,27*	-0,39*	-0,07*	-0,47
Healthcare	0,04*	0,02*	-0,12*	-0,28*	-0,35*	-0,73

For the period as a whole, from January 1979 until March 2013 all components, including headline KPI, have persistence significantly different from zero, except for Healthcare, Education and Food and non-alcohol beverages. As mentioned, this likely reflects changes in the mean of inflation for each component. More interesting I find evidence of declining inflation persistence for KPI from 0.71 and 0.66 in the two periods with fixed exchange rate to not significant different from zero after the krone started to float. Not surprisingly, this is reflected in the inflation persistence of the individual components. In the

last period of inflation targeting only Postal and Telecommunications and Food and non-alcohol beverages have inflation persistence significantly at the 5 percent level of -0.33 and -0.19 respectively. This is down from the previous period, where seven components showed sign of inflation persistence. A reflection of the success of inflation targeting perhaps, however one must keep in mind that other explanations for this decline is probable. However, it is likely that inflation targeting is at least partly responsible for this decline. I note, however that inflation persistence decreased considerably even in the third period when the krone started floating.

By inspection of the t-values over the periods I note that they also indicate that the components have become more stationary. I note that the first and second period had seven components with a t-value of under -2, the third period 5 and the last period none.

We note that the Housing component, while stationary, have a mean of 3.46 in the period after January 1999. As seen in the table of weighted contribution to the headline inflation, housing inflation has been larger, and in some years dominating the contribution, than its corresponding weight would suggest. This has helped Norges Bank to keep headline inflation closer to its target, since inflation has been below the target most of the time. However, one could claim that this is because of luck, instead of policy if Norges Bank has limited control over this component. This is something to keep in mind in case of potential problems in the future of controlling inflation.

Since my measure of inflation persistence and unit root tests are closely related, the results of the unit root tests follows a similar pattern. Results are shown in appendix B. I note that the KPI is stationary only in the last to periods with floating exchange rate. It is not stationary during the whole period from

January1979 until today either. I also note that there is a clear tendency of more components becoming stationary from period to period, with the notable exception from periods two to three. In the last period all but four of the components are stationary. The absolute t-values for the components that are not stationary are also high compared to previous periods.

9 Conclusion

Norges Bank can control inflation via monetary policy. Moderate inflation pressure will likely be easily contained by interest increases. However, current short-term interest rates are at 1.5 percent. Hence, monetary policy has present limited scope of inflating the economy if subjected to deflationary forces.

Norges Bank has limited control over some components in KPI. Most notably rent and imputed rent in the housing component. This violates that components in the CPI should be determined by market forces. Some prices are fully or partly politically determined. Some components are controlled mainly via the exchange rate channel. Evidence suggests that Norges Bank likely can control the exchange rate via the interest rate. If interest rates reach the zero bound Norges Bank will no longer be able to weaken the krone by interest policy. This might lead them to lose control over the exchange rate channel. That is, they will no longer be able to depreciate the krone by reducing interest rates.

If most of the weighted contribution to inflation comes from components outside the control of Norges Bank, this could lead to overly tight monetary policy, since it must then lower inflation in the components it can control. I found that this has been a factor in Norway, combined with the fact that inflation has generally been slightly below the target on average. Most notable is the large weighted contribution from imputed rents. However, this effect has not been

dramatic and should rather be seen as a warning of potential problems to come. Further there is some evidence that the components which Norges Bank can control, have declined in importance. Weighted contribution to inflation has shifted from coming largely from the goods sector to the service sector. Monetary policy has most likely the largest effect on the former. Larger than average inflation from the housing sector have over time increased its weights in KPI, hence further increasing its importance.

A prerequisite for inflation targeting to succeed is that headline inflation is stationary around the target. In Norway KPI has been stationary around about two percent inflation. Slightly less than the target, but must be considered largely successful. The individual components can have average inflation which differs from the target, however if Norges Bank influence those components by monetary policy they should preferably be stationary. I find that most of the components are now stationary as opposed to previous monetary regimes. I have also measured the components for inflation persistence which has decreased markedly as well. Lower inflation persistence shows that inflation return faster to baseline after a shock. I conclude that the above indicates that Norges Bank have been a successful inflation targeting central bank, and I attribute stationary inflation and lower persistence , both in the components and the aggregate, to anchored inflation expectations.

Norges Bank should consider removing imputed rent and politically determined prices from the measure of both the indicator and target of inflation. Extremely volatile components like books and air travel should be considered to be removed from measures of core inflation.

If in the future monetary policy shows inadequate to create inflation a more aggressive fiscal policy is recommended. That is, to increase the government deficit in Norwegian kroner. Possible more than what most observers would think of as compatible with HR. The same would be the case confronted with

inflationary pressure. Then the deficit in Norwegian kroner may be allowed to move towards a surplus. In the case of a inflationary deficit Norges Bank can use monetary policy to curb it. If the deficit is so small that it is deflationary there is not much the central bank can do to create inflation.

Since the measures, the indicators and target of monetary policy have some flaws, Norges Bank could focus more on wage growth and the exchange rate. It is hard to imagine high inflation rates without being caused by either a wage-price spiral or a markedly depreciation of the exchange rate. Since exchange rate pass-through takes years to play out, a longer horizon might be needed. The downside with looking at a longer horizon might be increased volatility in the short-term inflation rate. In general a longer horizon will reduce the problem of the central bank having limited control over the inflation of certain components in the medium-term.

I have noted that the components react to monetary policy with different time-lags. The speed at which headline inflation converges to core inflation depends on the persistence of components that contribute to most of the core inflation at a given point in time. A persistence-weighted measure of core inflation in the spirit of Cutler (2001) could improve the forecasting ability of Norges Bank while at the same time providing a more reliable time-frame. However, reduced inflation persistence has reduced the demand for such a measure.

References:

Andrews, Donald W.K and Hong-Yuan Chen (1994): Approximately median-unbiased estimation of autoregressive models", *Journal of Business & Economic Statistics*, 12 (2), 187-204

Angeloni, Ignazio, Anil K. Kashyap, Benoit Mojon, and Daniele Terlizzese (2002): Monetary Transmission in the Euro Area: Where Do We Stand, *European Central Bank Working Paper Series* No. 114

Arestis, Phillip and Malcolm Sawyer (2002): Can monetary policy affect the real economy?, The Levy Economics Institute, Working Paper No. 355

Arestis, Phillip, John McCombie and Warren Mosler (2006): New Attitudes About Inflation, *M.E. Sharpe, Inc*., 49 (5), 33-52

Aamodt, Ellen (2012): Petroleumsfondsmekanismen og Norges Banks valutakjøp til SPU, (In Norwegian. The Petroleum fund mechanism and Norges Bank's buying of foreign exchange to SPU), Norges Bank, Commentary No. 3

Batini, Nicoletta (2002): Euro area inflation persistence, ECB, Working Paper No. 201

Batini, Nicoletta and Edward Nelson (2002): The lag from monetary policy actions to inflation: Friedman revisited, Bank of England, Discussion Paper No.6

Ballinger, Rex and Stephanie Bell-Kelton Ballinger, Rex (2005): The Monetary Policy of Outcomes Curve: Can the Size and Structure of Public Debt undermine Policy Objectives? Editors Phillip Arestis, Michelle Baddeley and John McCombie. *The new monetary policy: implications and relevance*. Cheltenham, UK, Edward Elgar Publishing, 129-148

Benati, Luca (2008): Investigating Monetary Persistence Across Monetary Regimes, *Quarterly Journal of Economics*, 123 (3), 1005-1060

Bernanke, Ben .S. and Alan. S. Blinder (1988): Credit, Money and Aggregate Demand, *American Economic Review*, 78 (2), 435−439.

Bernanke, Ben. S. and Mark Gertler (1999): Monetary Policy and Asset Price Volatility, Federal Reserve Bank of Kansas City, issue Q IV, pages 17-51

Bleaney, Michael (2001): Exchange rate regimes and inflation persistence", IMF Staff Papers 47(3)

Blinder, Alan S. (1997): Commentary, Federal Reserve Bank of St Louis *Review* May/June 1997.

Bjørnland, Hilde C. and Håvard Hungnes (2006): The importance of interest rates for forecasting the exchange rate, Statistics Norway, Discussion Papers No. 340

Boug, Pål, Ådne Cappelen and Torbjørn Eika (2013): Exchange rate pass-through in a small open economy: the importance of the distribution sector. *Open Economies Review* 24(5), 853-879.

Brubakk, Leif and Tommy Sveen (2008): NEMO – a new macro model for forecasting and monetary policy analysis, Norges Bank, *Economic Bulletin* 80 (1), 39-47

Bulman, Tim, Alexandra Heath and Ivan Roberts (2004): Inflation in Australia: Measurement and Modelling. Editors Simon Guttmann and Christopher Kent, *The Future of Inflation Targeting*, Reserve Bank of Australia, 167-207

Burdekin Richard C.K and Pierre L. Syklos (1999): Exchange rate regimes and shifts in inflation persistence: Does nothing else matter?, *Journal of Money, Credit, and Banking*, 31 (2), 235-247

Campbell, John Y and Pierre Perron (1991): Pitfalls and Opportunities: What Macroeconomists Should Know About Unit Roots. Editors Olivier Jean Blanchard and Stanley Fischer. *NBER Macroeconomics Annual 1991*, National Bureau of Economic Research, 6,141-220

Catão, Luis and Marco E. Terrones (2003): Fiscal deficits and inflation, IMF Working Papers No. 03/65

Case, Karl E., John M. Quigley and Robert J. Shiller (2005): Comparing Wealth Effects: The Stock Market versus the Housing Markets, *Advances in Macroeconomics*, 5 (1), 1-32

Case, Karl E., John M. Quigley and Robert J. Shiller (2011): Wealth Effects Revisited 1975-2012, Cowles Foundation discussion paper No. 1884

Cutler, Joanne. (2001): Core Inflation in the UK, Bank of England, *External MPC Unit Discussion Paper No. 3*.

Dornbusch, Rudiger (1982): PPP Exchange Rate Rules and Macroeconomic Stability, *Journal of Political Economy,* 90 (2), 158–65

Eckstein, Otto (1981): Core Inflation. New York: Prentice Hall

Falch, Nina Skrove and Ragnar Nymoen (2011): The Accuracy of a Forecast Targeting Central Bank, *Economics: The Open-Access, Open-Assessment E-Journal*,Vol. 5, 2011-15.
http://dx.doi.org/10.5018/economics-ejournal.ja.2011-15

Fidjestøl, Asbjørn (2007): The central bank's liquidity policy in an oil economy, Oslo: Norges Bank, *Economic Bulletin* 4/2007

Flatner, Alexander and Preben H. Tornes (2002): Bankenes likviditet og Norges Banks likviditetsstyring (In Norwegian. The banking system's liquidity and Norges Bank's liquidity management), Norges Bank
http://www.norges-bank.no/Upload/Pengepolitikk/ZBSL.pdf

Fuhrer, Jeffrey .C. (2009): Inflation Persistence, Federal Reserve Bank of Boston, Working Paper No. 09-14

Gagnon, Joseph E. and Jane Ihrig (2004): Monetary Policy and Exchange Rate Pass-Through, *International Journal of Finance and Economics*, 9 (4), pp. 315-38

Gjedrem, Svein (2000): Norsk Pengepolitikk, (In Norwegian. Monetary Policy in Norway), Norges Bank, Copenhagen: Speech
http://www.norges-bank.no/no/om/publisert/foredrag-og-taler/2000/2000-11-17/
Accessed 10/14/2013

Grytten, Ola Honningdal and Hunnes, Arngrim (2009): Price Stability and Inflation Persistence during the International Gold Standard: The Scandinavian Case". NHH Dept. of Economics, Working Paper No. 6/2009

Hall, Simon (2001): Credit Channel Effects in the Monetary Transmission Mechanism, *Bank of England Quarterly Bulletin*, Winter, 442-448.

Hov, Marius Nyborg (2009): Teknisk Beregning av KPIXE (In Norwegian. Technical estimation of Consumer price index excluding energy and taxes), Norges Bank, Staff Memo No. 2009

Johansen, Ingvild (2007): Ny metode for flyreiser i KPI (In Norwegian. New methodology for flights in the Consumer price index), Oslo: Statistics Norway, Notes 2007/40

Johansen, Ingvild (2008): Ny metode for bøker i KPI (In Norwegian. New methodology for flights in the Consumer price index), Oslo, Statistics Norway, Notes 2008/45

Jonassen, Morten and Einar Wøien Norbø (2006). Indicators of underlying inflation in Norway, Norges Bank, Economic Bulletin 77 (4), 195-204

Klunde, Bastian E. (2011): Fra reell til nominell: En analyse av pengepolitikken i Norge fra devalueringen i 1986 til innføringen av inflasjonsmålet i 2001 (In Norwegian. From real to nominal: An Analysis of Monetary Policy in Norway since the devaluation in 1986 until implementation of Inflation Targeting in 2001), Oslo: Norges Bank, Staff Memo No. 20

Kuttner, Kenneth N. and Posen, Adam S. (2001): Beyond Bipolar: A Three-Dimensional Assessment of Monetary Frameworks, *International Journal of Finance and Economics*, *6*(4), 369-87

Levin, Andrew T. and Jeremy M. Piger (2003): Is inflation persistence intrinsic in industrial economies? , Federal Reserve Bank of St. Louis, Working Paper 2002-023

Locarno, Alberto , Julian Morgan, Peter van Els,and Jean Pierre Villetelle (2001): Monetary Policy Transmission in the Euro Area: What Do Aggregate and National Structural Models Tell Us? , European Central Bank Working Paper Series No. 94.

Marazzi, Mario, and Nathan Sheets (2007): Declining Exchange Rate Pass-through to U.S. Import Prices: The Potential Role of Global Factors, *Journal of International Money and Finance*, vol. 26 (10), 924-47

Marques, Carlos R. (2004): Inflation persistence: facts or artefacts, ECB, Working Paper No. 371

Ministry of Finance (2001): Report No. 29 to the Storting (2000-2001): Retningslinjer for den økonomiske politikken (In Norwegian. Guidelines for economic policy)
http://www.regjeringen.no/templates/Underside.aspx?id=194352&epslanguage=NO

Mishkin, Frederic S (2008): Exchange rate pass-through and monetary policy: a speech at the Norges Bank Conference on Monetary Policy, Oslo, Norway, March 7, 2008, Board of Governors of the Federal Reserve System (U.S.) 373
http://www.federalreserve.gov/newsevents/speech/mishkin20080307a.htm

The Monetary Policy Committee, Bank of England, (1999): The transmission mechanism of monetary policy
http://www.bankofengland.co.uk/publications/Documents/other/monetary/montrans.pdf

Naug, Bjørn and Ragnar Nymoen (1996): Pricing to market in a small open economy. *Scandinavian Journal of Economics*, 98, 329–350

Naug, Bjørn (2004): Factors behind movements in the krone exchange rate: an empirical analysis, Editors Øyvind Eitrheim and Kristin Gulbrandsen. *Explaining Movements in the Norwegian Exchange Rate*, Oslo: Norges Bank, Occasional Papers No. 32, 115-136

Nesbakken, Runa (2008): Selveiernes boligkonsum og vekt i KPI Estimeringer og diskusjon av metode (In Norwegian. Home owner's residential consumption and weight in CPI Estimations and discussion of methodology), Statistics Norway, Report 2008/9

Ng, Serena and Pierre Perron (1995): Unit Root Tests in ARMA Models with Data Dependent Methods for the Selection of the Truncation Lag, *Journal of the American Statistical Association*, 90, 268-281.

Norges Bank (2013): Indikatorer for prisvekst (In Norwegian. Indicators of inflation), http://www.norges-bank.no/no/prisstabilitet/inflasjon/indikatorer-for-prisvekst/, accessed 24/10-2013

Papadimitrou, Dimitri B and L. Randall Wray (1996): The Consumer Index as a Measure of Inflation and Target of Monetary Policy: Does the Fed know what it is fighting? , Levy Institute of Economics. Working Paper No. 164.

Roger, Scott (1998): Core inflation: concepts, uses and measurement, Reserve Bank of New Zealand, Discussion Paper No. G98/9

Rødseth, Asbjørn (2000): Open Economy Macroeconomics, Cambridge: Cambridge University Press 2000

Sand, Kathrine and Støholen, Bente (2008) Stigende Matvarepriser- en drivkraft for inflasjonen? (In Norwegian. Increasing Food Prices- a driving force for inflation), Norges Bank Economic Bulletin, 43 (2), 35-46

Schwert, G.William (1989): Tests for unit roots: a Monte Carlo investigation, *Journal of Business and Economic Statistics*, 7, 147-160

Silver, Mick (2006): Core Inflation: Measurement and Statistical Issues in Choosing among Alternative Measures, IMF Staff Papers, 54 (1), 163-190

Statistics Norway (2001): Konumprisindeksen 1995-2000, (In Norwegian. Consumer price index 1995-2000). Oslo, Statistics Norway

Statistics Norway (2013): Dekomponering av indeksendringer (In Norwegian. Decomposition of changes in the index) http://www.ssb.no/priser-og-prisindekser/statistikker/kpi/tilleggsinformasjon/dekomponering-av-indeksendringer, accessed 6/16-2013

Sørensen, Peter Birch and Hans Jørgen Whitta-Jacobsen (2010): Introducing Advanced Macroeconomics, Second edition McGraw Hill 2010, chapter 14, 389-421

Tauheed, Linwood and L. Randall Wray (2006): System Dynamics of Interest Rate Effects on Aggregate Demand, Money, Editors Mathew Forstater and L. Randall Wray. *Financial Instability and Stabilization Policy*. Cheltenham, UK, Edward Elgar Publishing, 37-58

Willis, J.L. (2003). "Implications of structural changes in the U.S. economy for pricing behavior and inflation dynamics", Kansas City: Federal Reserve Bank of Kansas City, *Economic Review*, First Quarter 2003, 5-27

Wynne, Mark A. (2008): Core inflation: A review of some conceptual issues, St. Louis: Federal Reserve Bank of St. Louis, Review, *90*(3, Part 2), 205-2

APPENDICIES

The data in the Appendix are taken from Statistics Norway's database. All calculations are mine. The calculations were made on PcGive.

Appendix A. Table Unit Root Tests on Seasonally adjusted Indexes.

Period S. January 1979 until June 2013

Component	$\gamma\pi_{t-1}$	**t-value** γ	**lag**	
Healthcare	-0,95801	-5,206	17	**
Education	-0,74307	-4,461	11	**
Alcoholic beverages and tobacco products	-0,60301	-4,103	11	**
Housing, Electricity and Fuel	-0,61312	-3,985	13	**
Transport	-0,49273	-3,646	14	**
Hotel and Restaurant services	-0,28777	-3,338	18	*
Other Goods and Services	-0,27949	-2,849	17	
Postal and Telecommunications services	-0,43042	-2,746	17	
KPI	-0,18882	-2,69	13	
Food and non-alcoholic beverages	-0,30253	-2,579	14	
Culture and Leisure	-0,19279	-2,5	11	
Furniture, Appliances and Household Goods Repair	-0,15082	-2,096	17	
Clothing and footwear	-0,23467	-1,906	17	

Period 1.January 1979 until August 1986

Component	$\gamma\pi_{t-1}$	**t-value γ**	**lag**	
Education	-1,03947	-9,133	0	**
Healthcare	-0,98164	-8,598	0	**
Other Goods and Services	-0,92037	-3,899	4	**
Food and non-alcoholic beverages	-0,63357	-2,338	9	
Alcoholic beverages and tobacco products	-0,74477	-2,19	11	
Hotel and Restaurant services	-0,50129	-2,105	5	
Culture and Leisure	-0,72413	-1,877	11	
Postal and Telecommunications services	-0,84378	-1,83	11	
Furniture, Appliances and Household Goods Repair	-0,51105	-1,776	11	
Transport	-0,40865	-1,361	11	
KPI	-0,26707	-1,336	12	
Clothing and footwear	-0,55607	-1,248	11	
Housing, Electricity and Fuel	-0,15199	-0,6774	12	

Period 2.September 1986 until December 1992

Component	$\gamma\pi_{t-1}$	**t-value γ**	**lag**	
Alcoholic beverages and tobacco products	-1,26517	-11,23	0	**
Healthcare	-1,11855	-9,851	0	**
Transport	-0,98813	-5,767	2	**
Hotel and Restaurant services	-0,971376	-5,082	2	**
Education	-0,77526	-3,2	3	*
Other Goods and Services	-0,49395	-2,803	7	
Food and non-alcoholic beverages	-0,35993	-1,708	12	
Postal and Telecommunications services	-0,53179	-1,472	11	
Furniture, Appliances and Household Goods Repair	-0,23519	-1,425	11	
Culture and Leisure	-0,23067	-1,228	11	
KPI	-0,16771	-1,119	11	
Clothing and footwear	-0,23141	-0,7221	12	
Housing, Electricity and Fuel	-0,08313	-0,313	11	

Period 3.January 1993 until December 1998

Component	$\gamma\pi_{t-1}$	**t-value γ**	**lag**	
Education	-1,025921	-8,586	0	**
Alcoholic beverages and tobacco products	-1,38754	-4,501	5	**
KPI	-1,16706	-4,134	5	**
Food and non-alcoholic beverages	-0,62929	-3,354	2	*
Healthcare	-1,28152	-3,097	11	*
Transport	-1,28566	-2,748	11	
Clothing and footwear	-1,39552	-2,338	11	
Culture and Leisure	-1,13915	-2,287	11	
Postal and Telecommunications services	-1,066588	-1,867	11	
Furniture, Appliances and Household Goods Repair	-1,14064	-1,8	12	
Housing, Electricity and Fuel	-1,00088	-1,725	11	
Other Goods and Services	-0,62541	-1,582	11	
Hotel and Restaurant services	-0,19967	-0,5838	11	

Period 4.January 1999 until June 2013

Component	$\gamma\pi_{t-1}$	**t-value γ**	**lag**	
Food and non-alcoholic beverages	-1,19171	-15,97	0	**
Alcoholic beverages and tobacco products	-1,070301	-10,42	1	**
Postal and Telecommunications services	-1,33872	-8,313	3	**
Housing, Electricity and Fuel	-1,66071	-4,778	12	**
KPI	-1,50228	-4,325	12	**
Clothing and footwear	-1,42756	-3,794	11	**
Healthcare	-1,35119	-3,61	12	**
Transport	-1,46771	-3,056	14	*
Other Goods and Services	-0,64828	-2,899	11	*
Hotel and Restaurant services	-0,988944	-2,691	12	
Culture and Leisure	-0,84452	-2,591	11	
Education	-0,70177	-2,557	11	
Furniture, Appliances and Household Goods Repair	-0,5724	-2,184	11	

A.6 Significance levels

The components are listed in descending order depending on the t-value of the ADF test. ** indicates significance at the 1% level, * at the 5% level.

t-values for the above tables ordered from 1 to 5:

Period	5%	1%
S	-2.87	-3.45
1	-2.90	-3.51
2	-2,90	-3.52
3	-2.90	-3.52
4	-2.88	-3.52

Appendix B. Inflation Persistence. Seasonally adjusted Indexes.

January 1979 until June 2013

Component	**Persistence, ρ**	**lag**
Furniture, Appliances and Household Goods Repair	0,84918	17
KPI	0,81118	13
Culture and Leisure	0,80721	11
Clothing and footwear	0,76533	17
Other Goods and Services	0,72051	17
Hotel and Restaurant services	0,71223	18
Food and non-alcoholic beverages	0,69747	14
Postal and Telecommunications services	0,56958	17
Transport	0,50727	14
Alcoholic beverages and tobacco products	0,39699	11
Housing, Electricity and Fuel	0,38688	13
Education	0,25693	11
Healthcare	0,041987	17

January 1979 until August 1986

Component	**Persistence, ρ**	**lag**
Housing, Electricity and Fuel	0,84801	12
KPI	0,73293	12
Transport	0,59135	11
Hotel and Restaurant services	0,49871	5
Furniture, Appliances and Household Goods Repair	0,48895	11
Clothing and footwear	0,44393	11
Food and non-alcoholic beverages	0,36643	9
Culture and Leisure	0,27587	11
Alcoholic beverages and tobacco products	0,25523	11
Postal and Telecommunications services	0,15622	11
Other Goods and Services	0,079693	4
Healthcare	0,018359	0
Education	-0,039477	0

September 1986 until December 1992

Component	**Persistence, ρ**	**lag**
Housing, Electricity and Fuel	0,91687	11
KPI	0,83229	11
Culture and Leisure	0,76933	11
Clothing and footwear	0,76859	12
Furniture, Appliances and Household Goods Repair	0,76481	11
Food and non-alcoholic beverages	0,64007	12
Other Goods and Services	0,50605	7
Postal and Telecommunications services	0,46821	11
Education	0,22474	3
Hotel and Restaurant services	0,028624	2
Transport	1,19E-02	2
Healthcare	-0,11855	0
Alcoholic beverages and tobacco products	-0,26517	0

January 1993 until December 1998

Component	**Persistence, ρ**	**lag**
Hotel and Restaurant services	0,80033	11
Other Goods and Services	0,37459	11
Food and non-alcoholic beverages	0,37071	2
Housing, Electricity and Fuel	-0,00088	11
Education	-0,025921	0
Postal and Telecommunications services	-0,066588	11
Culture and Leisure	-0,13915	11
Furniture, Appliances and Household Goods Repair	-0,14064	12
KPI	-0,16706	5
Healthcare	-0,28152	11
Transport	-0,28566	11
Alcoholic beverages and tobacco products	-0,38754	5
Clothing and footwear	-0,39552	11

January 1999 until June 2013

Component	**Persistence, ρ**	**lag**
Furniture, Appliances and Household Goods Repair	0,4276	11
Other Goods and Services	0,35172	11
Education	0,29823	11
Culture and Leisure	0,15548	11
Hotel and Restaurant services	0,011056	12
Alcoholic beverages and tobacco products	-0,070301	1
Food and non-alcoholic beverages	-0,19171	0
Postal and Telecommunications services	-0,33872	3
Healthcare	-0,35119	12
Clothing and footwear	-0,42756	11
Transport	-0,46771	14
KPI	-0,50228	12
Housing, Electricity and Fuel	-0,66071	12

Appendix C. Mean of Inflation for the Components over the Monetary Periods.

January 1979 until June 2013

Components	**Mean of inflation**
Hotel and Restaurant services	0,095282
Alcoholic beverages and tobacco products	0,059424
Education	0,052919
Housing, Electricity and Fuel	0,046793
Other Goods and Services	0,044976
Transport	0,044433
KPI	0,038767
Food and non-alcoholic beverages	0,036325
Culture and Leisure	0,032171
Furniture, Appliances and Household Goods Repair	0,026577
Clothing and footwear	0,006039
Healthcare	4,63E-05
Postal and Telecommunications services	-0,01512

January 1979 until August 1986

Components	**Mean of inflation**
Hotel and Restaurant services	0,10269
Alcoholic beverages and tobacco products	0,098831
Food and non-alcoholic beverages	0,093946
Other Goods and Services	0,089582
Housing, Electricity and Fuel	0,085069
Transport	0,085065
KPI	0,083934
Furniture, Appliances and Household Goods Repair	0,081034
Culture and Leisure	0,074566
Education	0,069268
Clothing and footwear	0,064754
Postal and Telecommunications services	0,060179
Healthcare	0,000417

September 1986 until December 1992

Components	**Mean of inflation**
Education	0,071995
Alcoholic beverages and tobacco products	0,069001
Clothing and footwear	0,056119
Housing, Electricity and Fuel	0,054553
Transport	0,053249
Hotel and Restaurant services	0,046753
Other Goods and Services	0,045735
KPI	0,045009
Culture and Leisure	0,043909
Furniture, Appliances and Household Goods Repair	0,032269
Food and non-alcoholic beverages	0,028
Healthcare	7,96E-05
Postal and Telecommunications services	-0,04003

January 1993 until December 1998

Components	**Mean of inflation**
Alcoholic beverages and tobacco products	0,051813
Education	0,042952
Other Goods and Services	0,031444
Hotel and Restaurant services	0,027279
Transport	0,026333
Food and non-alcoholic beverages	0,024356
KPI	0,020376
Housing, Electricity and Fuel	0,019259
Culture and Leisure	0,017652
Furniture, Appliances and Household Goods Repair	0,008671
Healthcare	1,16E-18
Clothing and footwear	-0,00178
Postal and Telecommunications services	-0,05226

January 1999 until June 2013

Components	**Mean of inflation**
Education	0,040066
Alcoholic beverages and tobacco products	0,037555
Housing, Electricity and Fuel	0,034558
Hotel and Restaurant services	0,032942
Other Goods and Services	0,026659
Transport	0,026588
KPI	0,019769
Food and non-alcoholic beverages	0,014572
Culture and Leisure	0,010821
Furniture, Appliances and Household Goods Repair	0,002706
Healthcare	-0,00015
Postal and Telecommunications services	-0,02869
Clothing and footwear	-0,04361

Appendix D. Weighted Contribution from the Components.

Weighted Contribution from the delivery sector.

Year	Goods	Services	Domestic Inflation	Imported Goods	Hous-ing	Trans-port	Rent
1980	76	24	86	14	19	17	6
1981	72	28	88	12	15	16	7
1982	68	32	82	18	18	14	9
1983	67	33	77	23	21	20	11
1984	72	28	79	21	22	15	11
1985	72	28	77	23	20	9	8
1986	71	29	66	34	11	18	7
1987	69	31	79	21	22	20	10
1988	58	42	82	18	28	21	18
1989	53	47	87	13	32	21	22
1990	61	39	89	11	33	22	18
1991	67	33	80	20	31	26	25
1992	45	55	90	10	31	30	29
1993	66	34	60	40	30	34	17
1994	71	29	72	28	21	23	7
1995	56	44	84	16	29	27	12
1996	52	48	123	-23	57	-5	16
1997	48	52	88	12	7	41	20
1998	39	61	94	6	8	5	10
1999	54	46	108	-8	37	30	17
2000	32	68	105	-5	43	28	29
2001	-2	102	96	4	87	17	42
2002	56	44	118	-18	68	13	22
2003	-93	193	279	-179	148	-13	109
2004	-28	128	104	-4	4	61	25
2005	41	59	109	-9	40	41	19

Weighted Contribution from the delivery sector. Continued.

2006	69	31	97	3	64	20	16
2007	64	36	112	-12	56	18	14
2008	27	73	107	-7	29	19	24
2009	41	59	73	27	1	26	24
2010	50	50	116	-16	82	14	24
2011	-463	563	120	-20	-443	98	236
2012	27	73	112	-12	45	23	25

Weighted Contribution from selected components. Part 1.

Year	Food and non-alcoholic beverages	Alcoholic beverages and tobacco products	Clothing and footwear	Furniture, Appliances and Household Goods Repair	Healthcare
1980	21	3	8	9	3
1981	27	5	9	9	1
1982	23	6	6	7	3
1983	18	4	6	8	1
1984	23	2	11	6	2
1985	23	3	12	7	3
1986	25	3	9	8	2
1987	14	6	9	7	1
1988	15	1	5	6	1
1989	9	3	5	3	2
1990	11	5	4	5	5
1991	15	8	6	4	3
1992	-6	14	3	1	7
1993	-1	3	8	6	3

Weighted Contribution from selected components. Part 1. Continued.

1994	18	11	1	3	4
1995	5	4	4	3	4
1996	26	5	-10	4	5
1997	20	10	-2	0	4
1998	35	12	-3	3	8
1999	8	4	-1	2	4
2000	10	6	-8	1	3
2001	-36	4	-4	2	4
2002	13	-1	-15	1	5
2003	68	-3	-121	-12	20
2004	13	25	-17	-14	9
2005	6	3	-11	2	4
2006	11	3	-12	-2	5
2007	13	1	-9	5	3
2008	27	6	-21	11	4
2009	16	6	0	6	5
2010	-2	3	-11	-1	2
2011	-14	176	-31	0	46
2012	-2	9	-8	1	6

Weighted Contribution from selected components. Part 2.

Year	Postal and Telecomm. services	Culture and Leisure	Education	Hotel- and Restaurant services	Other Goods and Services
1980	1	10	0	2	6
1981	1	9	0	5	3
1982	3	11	0	5	5
1983	2	11	1	3	6
1984	1	10	1	3	5
1985	-1	16	0	3	5
1986	0	12	0	3	9
1987	1	11	1	3	6
1988	0	9	0	3	8
1989	1	13	1	3	6
1990	-5	12	0	3	4
1991	-12	14	1	4	1
1992	-5	16	0	5	3
1993	-13	16	2	6	6
1994	-5	9	0	2	12
1995	-5	15	2	4	9
1996	1	7	2	4	4
1997	-4	8	3	4	11
1998	-4	9	3	9	14
1999	-6	9	2	3	8
2000	-1	3	2	5	8
2001	-3	6	2	9	12
2002	2	3	1	5	6
2003	-22	-21	4	18	33
2004	-4	13	0	6	5

Weighted Contribution from selected components. Part 2. Continued.

2005	1	5	0	4	6
2006	2	4	0	7	-2
2007	-7	8	0	6	5
2008	-5	11	1	7	11
2009	0	22	0	6	11
2010	-3	6	0	4	6
2011	-5	-44	7	105	204
2012	-13	2	2	12	23

APPENDIX E. AVERAGE INFLATION

January 1979- June 2013

Components	Inflation
Hotel and Restaurant services	9,53
Alcoholic beverages and tobacco products	5,94
Education	5,29
Housing, Electricity and Fuel	4,68
Other Goods and Services	4,50
Transport	4,44
KPI	3,88
Food and non-alcoholic beverages	3,63
Culture and Leisure	3,22
Furniture, Appliances and Household Goods Repair	2,66
Clothing and footwear	0,60
Healthcare	0,00
Postal and Telecommunications services	-1,51

January 1979- August 1986

Component	Inflation
Hotel and Restaurant services	10,27
Alcoholic beverages and tobacco products	9,88
Food and non-alcoholic beverages	9,39
Other Goods and Services	8,96
Housing, Electricity and Fuel	8,51
Transport	8,51
KPI	8,39
Furniture, Appliances and Household Goods Repair	8,10
Culture and Leisure	7,46
Education	6,93
Clothing and footwear	6,48
Postal and Telecommunications services	6,02
Healthcare	0,04

September 1986- December 1992

Component	Inflation
Education	7,20
Alcoholic beverages and tobacco products	6,90
Clothing and footwear	5,61
Housing, Electricity and Fuel	5,46
Transport	5,32
Hotel and Restaurant services	4,68
Other Goods and Services	4,57
KPI	4,50
Culture and Leisure	4,39
Furniture, Appliances and Household Goods Repair	3,23
Food and non-alcoholic beverages	2,80
Healthcare	0,01
Postal and Telecommunications services	-4,00

January 1993- December 1998

Component	Inflation
Alcoholic beverages and tobacco products	5,18
Education	4,30
Other Goods and Services	3,14
Hotel and Restaurant services	2,73
Transport	2,63
Food and non-alcoholic beverages	2,44
KPI	2,04
Housing, Electricity and Fuel	1,93
Culture and Leisure	1,77
Furniture, Appliances and Household Goods Repair	0,87
Healthcare	0,00
Clothing and footwear	-0,18
Postal and Telecommunications services	-5,23

January 1999- December 2013

Components	Inflation
Education	4,01
Alcoholic beverages and tobacco products	3,76
Housing, Electricity and Fuel	3,46
Hotel and Restaurant services	3,29
Other Goods and Services	2,67
Transport	2,66
KPI	1,98
Food and non-alcoholic beverages	1,46
Culture and Leisure	1,08
Furniture, Appliances and Household Goods Repair	0,27
Healthcare	-0,01
Postal and Telecommunications services	-2,87
Clothing and footwear	-4,36